THE

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THE

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1901 Edition

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IRREGULARITIES IN CONSULTING PRACTICE.

IF there is one point more than another upon which we as a nation are able to pride ourselves, it is the fact that our business transactions are carried out on honourable lines, and that our commercial methods will bear the investigations of a Court of Law.

That there have been, and always must be, exceptions to such high principles, is only to be expected, though in comparison with the standard of morality adopted in most other countries, it may be claimed, without unduly flattering ourselves, that we set a good example. It is not necessary to go abroad to find that corruption is practised to a large extent among traders of certain nations; a glance at some of their methods when they come to this country to sell their wares, is sufficient proof that it forms part of their distributing system.

Whilst the electrical industry is still comparatively young, most probably a keener competition already exists in this than in any other industry, a competition not only not limited to home manufacturers, but considerably increased by the efforts which foreign firms are making to obtain a share of our home and Colonial trade.

It can be confidently felt that our manufacturers will not be tempted, on the pretext of fighting their competitors on an equal footing, to depart from the high moral business attitude for which we are renowned and respected. On the other hand, it can, we think, be safely assumed that our competitors, be they manufacturers abroad, or those that have come to work among us, will be shown the necessity of conforming to British methods of doing business.

It is not too much to say that when it is appreciated that business can be obtained over here and in our Colonies without bribery, others will gladly conform to our own ideas on the subject. In a country where corruption is the order of the day, little can be done without it; this, however, is not the case with us, and there can be no excuse for introducing it.

In the present article we do not wish to enlarge on the question of corruption and bribery, but rather to point out that certain irregularities are being practised in the electrical industry which, though perhaps harmless in some cases, in others lend themselves to misinterpretation and abuse by those that care to take advantage of them.

There is little doubt but that the much-condemned consulting engineer, to whom the blame for the backwardness of the electrical industry in this country is, by some people, largely ascribed, may be, and in many cases is, a great help in forwarding the interests of the industry.

A consulting engineer, unbiassed in his opinions, and well versed in what has been, and what can be, done in his particular line of work, is of the greatest help to manufacturers, contractors, and the industry in general.

Unluckily, however, there are some engineers who are not

beyond reproach, and in some instances, their relations with manufacturers cannot be called altogether discreet; further, their experience is sometimes so limited that they are barely qualified to take up the positions which they obtain.

With regard to the first point, we do not wish to say that there are many cases where a practice is made by consulting engineers of showing preference to certain manufacturers, by which they benefit unknown to their clients, but at the same time there are more examples than there should be; and, further, it is difficult to see how those who practise in a consulting capacity, and at the same time form part of a ring in which manufacturers are interested, can expect to be free from criticism. Cases of this description are not unknown, and it is the greatest hardship on our consulting engineers as a body that this sort of thing should exist.

Next, an irregularity to which exception must be taken, and which is being practised in some cases by those posing as consulting engineers, consists in playing the double part of drawing up specifications and reporting upon tenders for machinery, and at the same time, of designing machines for manufacturers.

This places independent firms at a disadvantage, as it is quite impossible for a consulting engineer carrying on this practice to report fairly on tenders and to draw up specifications which will not assist the firms for whom he designs.

Another form of irregularity consists in a contractor officiating as a consulting engineer. Although this is frequently done, it cannot be expected that a person who usually acts as a contractor can for the time being sever himself from the relations existing between himself and certain manufacturers—relations often involving a rebate on the sum total of business done in the year—and place himself in an independent and unbiassed position.

As already mentioned, a fair consulting engineer is of considerable assistance to our manufacturers, but if members of the profession practise irregularities of this description, it cannot be wondered at that the more responsible manufacturers have strong feelings against consulting engineers as a body, and prefer as far as possible not to quote to their specifications.

This feeling would not be so prevalent if there were less abuse made of the term "consulting engineer."

If a firm calls in an engineer to prepare a scheme, and is aware that his practice falls under one of the headings just mentioned, little exception can be taken to the arrangement; in that case, however, only the few favoured manufacturers should be asked to tender, and other outside makers should not be put to the expense.

The last point which we propose to mention here is the course which is being followed to some considerable extent in this country, and one which we hold forth as being grossly unfair to the electrical industry in general.

This consists in consulting engineers, often of the stamp mentioned above, posing as contractors, and inviting tenders in their own name, in this way obtaining terms which only those who buy for purposes of reselling are entitled to, and to which their clients, on whose behalf they buy, have no right.

It has come to our knowledge that engineers have secured appointments in a consulting capacity by representing to their clients that they can obtain better terms by buying for them than they themselves can buy at, in this way enabling them to obtain the opinions of an adviser, who buys for them, and superintends the erection on their behalf, at a smaller cost than they could even buy the machinery at.

Preferential discounts are naturally given to contractors who buy machinery for reselling, and who have to take all responsibility in erecting the plant, and it is only reasonable and normal that terms, say, 10 per cent. higher than these should be quoted to firms who buy for their own use. That these firms should be enabled to buy at the lower terms through a man who acts for them as a consulting engineer, and poses to the manufacturer as a trade buyer, is not only unfair to our manufacturing firms, but still more, if possible, to the trade contractor who earns his living in this way.

It may be contended that manufacturers should not sell at an unprofitable price, but in reply we would say that although this is not necessarily done, yet the profit rightfully reserved for the trade contractor is transferred to the buyer.

Every encouragement should be given to the trade contractor, for it is he who is chiefly instrumental in extending various electrical applications, which individually are too small for the manufacturer to deal with personally, but which in the aggregate go some considerable way towards extending the usefulness of electrical work.

Therefore, if a manufacturer quotes prices to a user, which neither benefit the contractor, nor yet increase his own profits, the gains are transferred from the electrical industry to some other industry, and consulting engineers should not be the means of so doing.

A consulting engineer has no right to call for tenders in his own name, but in that of his client, though the best way is for him to prepare the specification, and for his clients to invite tenders in their own names.

If the irregularities to which we have referred continue, it seems to us that manufacturers will have to combine, and refuse to quote where such practices exist.

The matter cannot be dealt with by manufacturers independently, chiefly because these details are not commonly known at the time of tendering. This is therefore essentially a case where a committee formed amongst the manufacturers would be of service, and save a good deal of time and expense in quoting—to say nothing of checking some of these practices, which are undesirable and unhealthy in any industry.

The Neuhausen Aluminium Works.—The annual report of the Aluminium Industrie Aktien Gesellschaft in Neuhausen for the year 1900 has recently been issued. The three factories at Neuhausen, valued at 4·82 million francs, at Rheinfelden, 5·71 million francs, and at Lend, 3·61 million francs, have been busily occupied all the time, and the gross revenue was 2,109,125 francs for the year, an increase of 167,000 francs. The dividend declared is 12½ per cent. instead of 13, but 79,718 francs are carried forward in place of 2,400. All the patents have been written off. The total capital is 16 million francs, half of which is paid up, and the reserve fund stands at 340,000 francs.

CAPACITY CURRENTS AS INFLUENCED BY FREQUENCY.

By T. MATHER, Wh. Sch.

In the discussion on Mr. Mordey's paper "Capacity in Alternating Current Working" at the Institution of Electrical Engineers on February 14th, I exhibited tables of figures showing that the current taken by a condenser, when subjected to a given alternating P.D. at fixed frequency, depended greatly on the alternator used, and on the load under which a particular machine was working. These changes of current at fixed P.D. and constant frequency were attributed to differences of wave form of the several machines, and the alteration of wave form of a given machine with varying loads.

During the tests on the effect of load, I noticed that an increase of speed of the machine was sometimes accompanied by a diminution of condenser current, whereas the opposite would have been expected. Want of time prevented this part of the subject being referred to at the meeting. It may, therefore, be of interest to give the results of experiments made at the Central Technical College on the influence of frequency on capacity currents supplied by a machine having a somewhat peaked E.M.F. wave, and to show the wave forms of current and P.D. actually obtained.

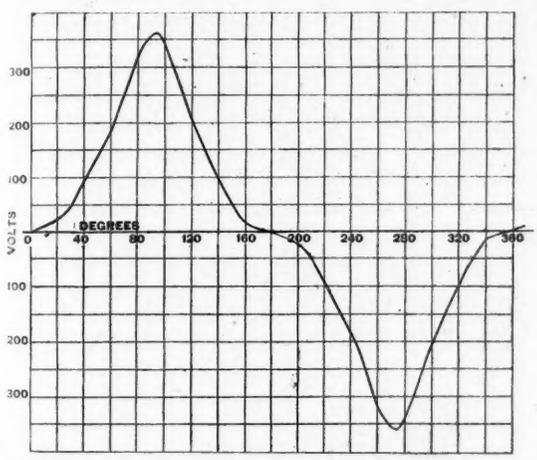


Fig. 1.—E.M.F. Wave of Pyke & Harris 6-K.W. Inductor Alternator. Speed 810 r.p.m. (95 ~). Exciting current 1·17 amperes. R.M.S. volts, 181.

The experiments were carried out on 10 Varley condensers of total capacity about 50 microfarads, having paraffined paper as dielectric. The machine used was a 6-KW. Pyke and Harris inductor alternator giving seven complete periods per revolution. Its normal E.M.F. wave is shown in fig. 1, from the shape of which it is evident that the wave has a very large third harmonic in anti-phase. Analysis shows that the fifth, seventh, and ninth harmonics present are of considerable importance, for the amplitude of the fundamental and four odd harmonics are in the proportions 100 : 33·4 : 5·8 : 2·9 : 2·0.

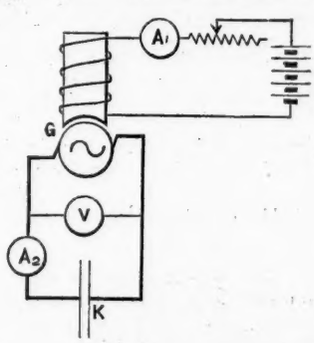


Fig. 2.—Diagram of Connections for Experiments represented in Curves on fig. 3.

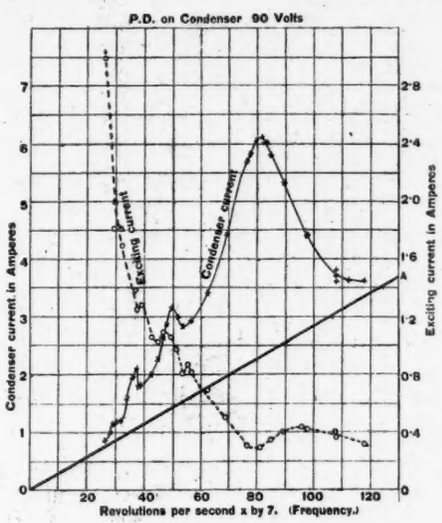

P.D. on Condenser 90 Volts
Condenser current in Amperes
Exciting current in Amperes
Exciting current
Condenser current
Revolutions per second x by 7. (Frequency.)

Fig. 3.—Relation between Condenser Current and Speed of Machine when Condenser is connected directly to Machine Terminals, and P.D. kept constant at 90 volts by varying the exciting current.

Tests were made by keeping the P.D. on the condenser constant in each set of experiments, and observing the currents taken by the condenser for different speeds of the generator. In one series of observations the condensers were connected directly with the machine terminals, except for the introduction of a hot-wire ammeter of low resistance.

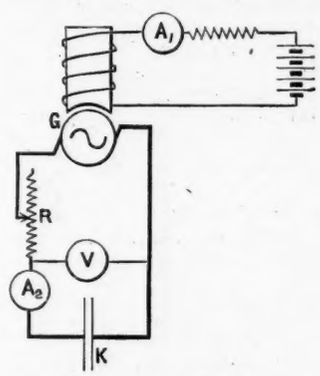


Fig. 4.—Diagram of Connections for Experiments represented in Curves on fig. 5.

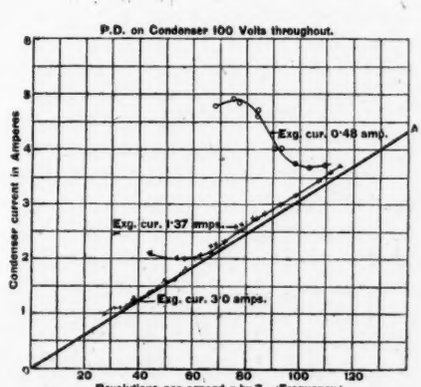

P.D. on Condenser 100 Volts throughout.
Condenser current in Amperes
Exg. cur. 0·48 amp.
Exg. cur. 1·37 amps.
Exg. cur. 3·0 amps.
Revolutions per second x by 7. (Frequency.)

Fig. 5. — Relations between Condenser Current and Speed of Machine, when Exciting Current is constant and the P.D. on the Condenser is kept constant at 100 volts by inserting non-inductive resistance in series.

The P.D. was controlled by varying the exciting current supplied to the machine from storage cells.

A diagram of the connections is given in fig. 2, in which K indicates the condenser, G the generator, V a voltmeter, A_1 an ammeter in the exciting circuit, and A_2 the ammeter showing the condenser current. The results obtained are plotted in fig. 3, which shows the effect of varying the speed of the machine on both the capacity current taken by the condenser and the exciting current necessary to give a P.D. of 90 volts between the machine terminals. On the same diagram a line O A is drawn, indicating the relation between capacity current and frequency for a pure sine wave alternator.

In a second set of tests the connections were arranged as shown in fig. 4, the exciting current being kept constant at several definite values, and the P.D. on the condenser maintained at 100 volts (R.M.S.) by regulating a non-inductive resistance R in series with the generator armature. The results obtained are shown in fig. 5, which gives three curves corresponding with exciting currents 0·48, 1·37, and 3·0 amperes respectively. The line O A again indicates the relation between normal capacity current and frequency.

In each of the curves shown in figs. 3 and 5, the lower limits of speed were determined as the lowest at which the required P.D. could be obtained between the terminals of the condenser when the resistance, R (fig. 4), was cut out, and the upper limits (except in the case of the 3-ampere exciting current) by the highest speed at which it was considered safe to run the machine.

The characters of the curves in fig. 3 show in a striking manner the abnormal values of capacity current obtained from the Pyke and Harris alternator, and also illustrate the well-known fact that alternators can be excited by armature currents of leading phase.

It will be seen from fig. 3 that, at the lowest and highest speeds obtainable, 28 and 118 respectively, the condenser currents do not differ much from the normal values given by

$$A = \frac{F V p}{10^6},$$

but at a frequency of 81 the current is 6·15 amperes instead of 2·3 amperes, the former being 2·68 times the latter. Well defined peaks also occur at frequencies 49 and 37 respectively, and an inclination to a peak about 29 ~. The

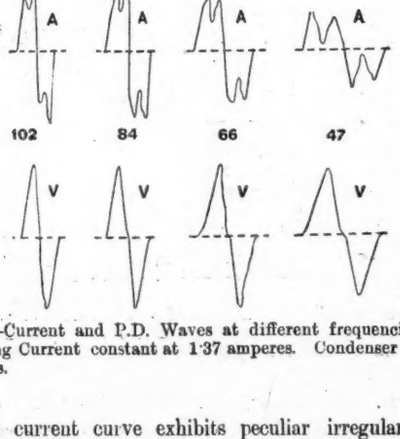


Fig. 7.—Current and P.D. Waves at different frequencies. Exciting Current constant at 1·37 amperes. Condenser P.D. 100 volts.

exciting current curve exhibits peculiar irregularities at about the same frequencies, its tendency being to show minimum values where the condenser current curves show maxima. This rule, however, does not appear to hold for the peak on the latter curve at frequency 49.

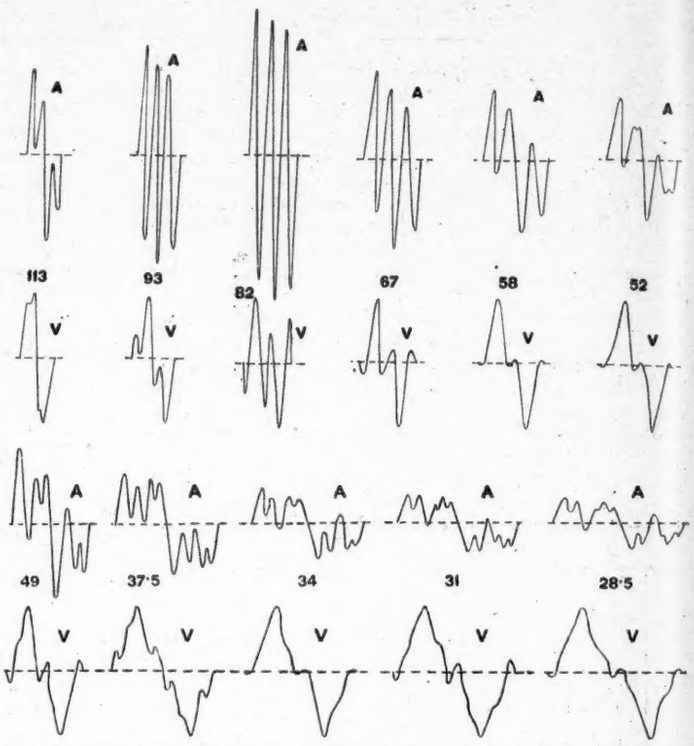


Fig. 6.—Current and P.D. Waves at different frequencies. Condenser direct on Generator. P.D. 90 volts.

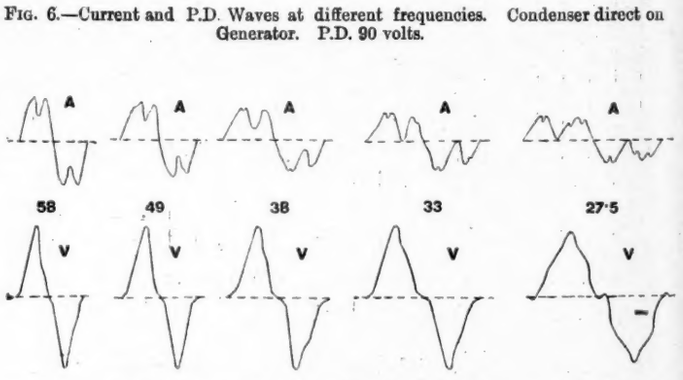


Fig. 8.—Current and P.D. Waves at different frequencies. Exciting Current constant at 3 amperes. Condenser P.D. 100 volts.

The frequencies at which the peaks occur on the condenser current curve being in the ratios of $\frac{1}{3} : \frac{1}{4·95} : \frac{1}{6·57}$ and $\frac{1}{8·54}$, naturally suggested that they were due to the third, fifth, seventh and ninth harmonics in the E.M.F. wave of the machine, and that at these particular speeds the circuit was in resonance with these components. This idea was confirmed by calculating the self-induction of the machine from the resonance formula

$$h F p^2 = 1$$

where h = inductance in henrys

$$F = \text{capacity in farads} = \left(\frac{49·4}{10^6}\right)$$

and $p = 2\pi$ times the frequency of the harmonic considered, and comparing the values thus found with the known inductances of the alternator.

The results are tabulated below :—

Frequency of		Calculated value of h.	Exciting current.
Fundamental.	Resonating harmonic.		
81	243	0·0087	0·29
49	245	0·0086	1·06
37	259	0·0076	1·25
29	261	0·0075	2·2

These show a progressive decrease of inductance with increase of exciting current, and the numbers obtained are in fairly close agreement with those got by secohmmeter and impedance measurements, which give values decreasing from 0·011 to 0·0077 as the exciting current changes from 0 to 2·25 amperes.

The fact that the magnitudes of the peaks on the condenser-current curve are approximately in the proportion of the amplitudes of the corresponding harmonics in the E.M.F. wave, suggests the possibility of analysing alternator curves by aid of a current-frequency curve such as that shown in fig. 3.

The peculiar character of the curve between condenser current and speed led me to examine the wave forms of current and P.D. throughout the whole range of speed. This was rendered comparatively easy through the kindness of Mr. W. Duddell, who lent me his portable oscillograph for the purpose. In this instrument (which is all self-contained in a small box weighing only a few pounds) the wave form is viewed in a revolving mirror turned by hand, the illumination being derived from a glow lamp usually run off the same circuit as the wave form under examination. The waves thus observed were sketched, and a few of them are reproduced in fig. 6. Some of the waves obtained under the conditions which give the curves in fig. 5 are shown in figs. 7 and 8. In each case these waves have been drawn to the same time-scale—*i.e.*, base length inversely proportional to frequency—and in order to show the changes of condenser current, the maximum heights of the waves are made proportional to the R.M.S. values.

In each of the figs. 6, 7 and 8, the wave forms marked A are current waves, those marked V, P.D. waves, and the number between each pair gives the frequency of the fundamental component of the E.M.F. wave. Only a selection of the many curves taken are given here, but they serve to show the progressive changes in the wave forms as the speed of the machine was varied. Examining those shown in fig. 6, it will be seen that the waves become more sinuous about the frequencies corresponding to the peaks in fig. 3, and the influence of the resonating harmonics is plainly visible. It is thus possible to derive a nearly pure sinusoidal curve from an alternator giving a very peaked wave-form by suitably resonating one of the components. The changes that occur in the current waves are more marked than those in the P.D. waves. It is also interesting to notice that the current waves taken at frequencies on opposite sides of the high peak in fig. 3 are very similar in form, whereas the corresponding P.D. waves differ considerably in the way they cross the zero line. (Compare ~'s 93 and 67, fig. 6.)

The wave forms shown in figs. 7 and 8 were obtained under the conditions previously mentioned, viz., constant exciting current and constant condenser P.D. regulated by a non-inductive resistance in the main circuit, as shown in fig. 4. Here the P.D. waves are very similar to each other throughout the whole range of speed, but the current waves differ considerably, though not to the same extent as those in fig. 6. This is doubtless due to the inserted resistance checking the resonance effects, which would otherwise become important. At the lowest frequencies, however, where the added resistances become small, the shapes approximate to the corresponding ones in fig. 6. (Compare ~'s 33 and 27·5 of fig. 8 with ~'s 34 and 28·5 respectively of fig. 6.) It is also interesting to notice that all the curves in fig. 5 show distinct indications of resonance.

In conclusion, I would recall attention to the great importance of the higher harmonics of E.M.F. waves in alternating current supply systems, and the risks to which cables in such systems are subjected thereby. Although the capacity of a network of cables may be far too small to produce resonance effects at the normal frequency at which the plant is operated, it is quite possible that the higher harmonics may resonate, for, as is well known, the capacity required to produce resonance in a circuit of given inductance varies inversely as the square of the frequency. The third harmonic will therefore resonate with one-ninth the capacity required by the fundamental, and the fifth harmonic with one twenty-fifth of that capacity, whilst the components of greater frequency require still less capacity. When it is kept in mind that a resonating component sends a current through the system, depending only on the ohmic resistance of the system and the magnitude and frequency of the component, it will be evident that currents and P.Ds. on the cables may become large quite unexpectedly. Small changes of speed, or change of inductance or capacity caused by switching on or off transformers or cables, may bring the circuit into resonance and subject the cables to serious electric stress.

My best thanks are due to Mr. Duddell for the loan of his oscillograph, and to Messrs. Duncalfe, Fasola, Harrold and Griffin, students of the Central Technical College, who have rendered very valuable assistance in carrying out the experiments here described.

POWER SUPPLY FROM ALTERNATING CURRENT STATIONS.

That all-important factor in the economy of a central station, the motor load, has of late years greatly absorbed the attention of engineers, and in most direct current central stations large strides have been made in the direction of levelling up the load curve, and improving the load factor by the inducements offered to power consumers to replace their small steam and gas engines by electric motors.

Single-phase alternating current stations have, however, been to a great extent debarred from entering the profitable field of power supply, by the prejudice which exists against the single-phase motor.

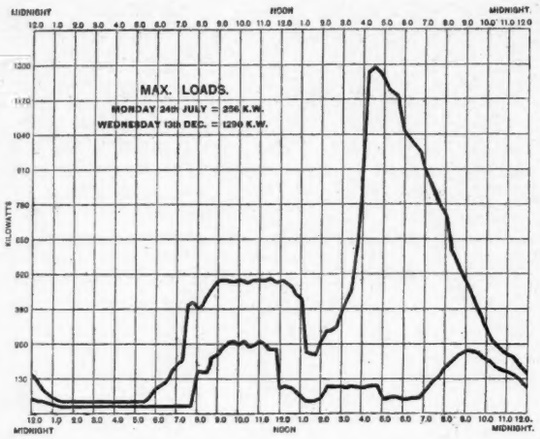
The advantages and disadvantages of this type of motor have been thoroughly discussed in many places. Although great improvements have been, and are being, made in starting methods and general efficiency, the direct-current motor undoubtedly finds the greatest favour in the eyes of both engineers and consumers. In order to compete in power supply on level terms with their direct current brethren, many alternating current station engineers are putting down direct current plant and mains especially for this purpose, and the following is an outline of the method which has up to the present been generally pursued. The installation of separate direct-current steam plant is, naturally, the system which first suggests itself, but it is questionable whether it is advisable to start in this manner, even in a district which promises great things in the direction of power consumption.

The fundamental idea should be to improve the load factor of the alternating current plant during the day ; and as has been shown by the County of London and Brush Provincial Company, this can best be effected by the use of motor-generators. This company started its direct-current power supply with motor-generators, and to meet the rapidly-growing demand, installed large steam sets. There can be no doubt that in both large and small districts it is best to start with motor-generators. In the latter, very possibly the demand for power will not outgrow the amount that can be economically supplied in this way ; but in the former it is sure to, and when it shows signs of doing this, the time has come to instal steam plant.

Transformation by motor-generators is necessarily somewhat inefficient, especially at light load, but up to a certain point the improvement in the alternating current load factor nullifies the losses incurred in transformation, and shows a balance on the right side. The point where the losses begin to tell of necessity varies with the size of both the alternating steam plant and the motor-generators ; and considering this, it is manifestly impossible to lay down any hard-and-fast rule as to when steam plant should be installed ; it can, however, be easily worked out for any

case, and as a matter of fact, the weekly return of costs will, if carefully gone into, tell their own tale.

The accompanying diagram is taken from the article on the City Road station of the County of London and Brush Provincial Company, published in the ELECTRICAL REVIEW, Vol. 46, No. 1,164. It contrasts the summer and winter



CITY ROAD STATION; LOAD CURVES, SUMMER AND WINTER, 1899.

load curves of that station, and is of interest, as it points to the value of motor-generators for power supply on what was then a comparatively small scale.

The rises in the two curves between 7.15 a.m. and 1.15 p.m. in the case of the larger or winter curve, and between 7.45 a.m. and noon on the smaller one, are chiefly composed of current supplied to the motor-generators for transformation to direct current at 550 volts, part of which was used for charging the battery, and the rest for the supply to the mains.

It is obvious that these rises greatly improve the load factor, especially in the summer curve, which is generally the one that needs it most. The drops at 1.15 p.m. and noon, respectively, were caused by the motor-generators being shut down, the power load then being taken up by the battery. In the case of the summer curve, it will be noticed that if the power load after mid-day had been large enough to make it worth while, the motor-generators could have been run for it, and so have produced a flat topped curve, extending from 8 a.m. to the time of maximum load at 9 p.m., or thereabouts.

With a battery in parallel, motor-generators can be made very useful in filling up the hollows in a load curve; for instance, as the evening lighting load comes on, the power load can be gradually shifted on to the battery, keeping the load on the engines approximately constant; also in the case of a very slow rising load, when it becomes necessary to put in another machine, which, in the ordinary way, would probably be running for some time comparatively light, the motor-generators can be made to take up the power supply from the battery, and so maintain the steam sets at an economical load.

A very useful feature of the motor-generator is the fact that it will motor or generate on either side with equal ease, and, if so designed, with equal efficiency. Use can be made of this feature during the hours of lightest load—that is to say, between midnight and 6 or 7 a.m., when the lighting load is almost negligible and the power load *nil*.

Provided the battery is of a reasonable size in comparison with the station output, it should easily be capable of running the night load through a motor-generator for, say, six or seven hours, during which time nearly all the steam pipe could be shut down. This, of course, only applies to stations where the night load is so small as to be considerably under the capacity of the smallest steam set. Naturally, in cases where the night load is large enough to keep an engine running at or near its maximum horse-power, it is more efficient to generate direct, and so save the losses inherent in a double conversion, and the inefficiency of the battery. In such a case, probably the most efficient arrangement is that of charging the battery at night. This should materially improve the load factor, and convert a very inefficient period of the 24 hours into one that at least pays its own way. Practically all the foregoing applies only to stations which are solely dependent on motor-generators for their power supply; when steam sets also are installed, another phase of the question is opened up. The power load is, of course, heaviest during the day time, and naturally the steam sets will be run to meet it. It is here that the flexibility of the motor-generator can be taken advantage of with the greatest effect. The steam-alternating plant can be shut down, and the load taken up on the motor-generators, which, of course, are supplied with power from the direct current steam sets. The load on most alternating current stations during the day time is inconsiderable, and should easily be within the scope of quite a small motor-generator. There is only one slight drawback to this system, and that is the difficulty that is sometimes experienced in synchronising in an emergency. The power load is necessarily continually varying, and with it the voltage of the system, and therefore the speed of the motor-generators; however, this is not of extreme importance, as motor-generators being very light machines, will pull into step very readily, even under conditions where a comparatively heavy steam set would blow its fuse, or refuse to settle down.

The battery is, of course, an indispensable feature where motor-generators are installed; it is necessary, not only for starting the machines, but to act as a buffer when they are running the power load. In power supply, as in traction work, short circuits and other great rushes of current are of frequent occurrence, and a bad short circuit on mains unprotected by circuit-breakers, and being fed by a single motor-generator, means one of two things, either the motor-generator circuit-breaker will open, or the machine will be pulled out of step with the alternating plant, and blow its high tension fuse, in either case totally cutting off the supply. If the feeders are each protected by a circuit-breaker set to open below that of the motor-generator, this, of course, should not happen; but where wire fuses are employed on the feeders, the motor-generator circuit-breaker is almost sure to operate first, even if the feeder fuses be designed to blow considerably under its opening point. This is due to the well-known fact that the time lag of wire fuses is much greater than that of circuit breakers.

A battery in parallel will, however, obviate all this trouble; the sudden increase of current will cause the motor-generator volts to drop, thus throwing almost the entire load on the battery, which, with its large reserve of power, is of course more fitted to deal with the emergency.

There is nothing very difficult in the simple running of alternating to direct motor-generators, but when they are in parallel on one side with the alternating steam plant, and on the other with the direct current steam plant, complications often arise which for the moment are apt to be confusing.

It is obvious that the motor-generator forms a link between the two systems, so that a disturbance on the one is always more or less felt on the other. For instance, suppose two alternating sets are running in parallel, fairly loaded, supplying current to the mains and also to a motor-generator, the continuous current side of which is in parallel with the continuous current steam sets. Now suppose one of the alternating sets breaks down, and has to be immediately switched out.

The overload on the remaining alternator will pull it up; the motor-generator being synchronous will also drop its speed, and therefore its volts on the continuous current side; this will cause a rush of current into it on this side, which will then motor and drive the alternating side as a generator; the machine thus temporarily taking the place of the disabled alternator. If at the moment there is plenty of power to spare on the direct current system, as there probably is owing to the battery being in parallel, and if the capacity of the motor-generator is not greatly beneath that of the disabled machine, there should be simply a flicker on the lights, and a slight drop in the direct current volts. Of course under less favourable circumstances there might be a considerable drop in volts on both sides, but in any case the motor-generator would be found very serviceable. All the above would take place automatically; after the faulty machine was switched out, the motor-

generator direct current brushes would be rocked back from the forward position of generating, some resistance put in the direct current field circuit in order to raise the speed, and some taken out of the alternating side so as to raise the volts. The synchronising of another steam set could then be proceeded with, and the plant returned to its normal condition of running. There are many other cases like the above that might happen, and almost all of them can be met with equal facility.

The usual switching gear for motor-generators consists of the following :—On the alternating side: main switch, fuse, ammeter, field switch, regulating resistance and field ammeter. The voltmeters and synchronising gear would, of course, be that used for the alternating generators, unless the motor-generators are on a separate board, which is not desirable, as in emergency it is well to have all the switches and instruments near together. On the direct current side : a circuit breaker, set to open at about 75 per cent. overload, starting switch, ammeter, voltmeter and field regulating resistance of wide range and many contacts.

Whether a field switch is necessary or not is a matter of opinion. In the event of a "burn up" on the direct current side it would, no doubt, be very useful ; but, on the other hand, it is apt to be a danger in starting up, as unless it is interlocked with the starting switch it is quite possible to forget to close it before closing the latter. If a field switch is dispensed with, the field winding is best connected in short shunt across the machine terminals, in which case it is made alive on closing the circuit-breaker and starting switch ; these should be in series in the positive side, and the negative, or outer, should be earthed throughout the entire system. It is advisable to place the direct current board in as close proximity to the alternating board as possible ; the two boards have usually to be worked together, and the closer they are the better the work can be carried out.

Starting up is performed as follows :—The continuous current brushes are rocked into the motoring position, the circuit-breaker and starting switch are now closed, the circuit-breaker first, care being taken that the direct current field resistance is all out, as this reduces the starting current to a minimum ; the alternating side field switch should now be closed, also the synchronising switch. The machine should now be brought into synchronism by the manipulation of the continuous current shunt regulating resistance, increasing or decreasing it according to whether the machine needs to run faster or slower. If, as is sometimes the case, the resistance is too coarse to be of much use for delicate speed regulation, the motor-generator can always be brought into synchronism by very slightly rocking the continuous current brushes, backward for more speed, and forward for less.

When synchronism is attained, the alternating main switch is closed, and the motor-generator is now running as a motor on the continuous current side, and as a generator on the alternating side, in parallel with the steam sets, but doing no work. The continuous current brushes should now be rocked forward and some resistance taken out of the shunt until the machine has picked up the desired load. Resistance should also be taken out of the field on the alternating side, just as would be done when loading up a newly-paralleled steam set. A motor-generator should never be started up with the alternating field switch on, as the starting current is much greater, owing to the power absorbed by the eddy currents and hysteresis set up in the armature directly rotation takes place.

Stopping is a simple matter ; after the load is taken off, either the circuit-breaker or the alternating main switch may be opened, it is immaterial which ; the machine will now slow up, and if it be desired to stop quickly the alternating field should be left on, this having the effect of pulling it up much quicker on account of the reasons before stated.

The above does not pretend to be the only solution to the problem of power supply from alternating current stations, but it is one that has been tried and found very successful. Local conditions, varying as they do, must of necessity be the determining factor in each separate case, but there is no doubt that the above system of motor-generators, alone or combined with steam sets, is one, the efficiency of which recommends itself as a remedy for the trouble that many single-phase alternating current stations are suffering from, viz., their inability to hold their own in the great field of power supply.

NOTES ON THE THEORY OF SYNCHRONOUS MOTORS AND OF ALTERNATORS IN PARALLEL.

By ALEXANDER RUSSELL, M.A.

The ordinary theory of the working of an alternator whether acting as a dynamo or a motor gives results which in many cases agree very closely with experiment. For example, the well-known V curves, showing the relation between the excitation of a synchronous motor and the current through it, can be closely imitated by constructing the curves got by plotting out the lengths of a line in a triangle as an angle and a side vary. In addition the fall of P.D. at the terminals of an alternator on an inductive load and its rise on a condenser load are all satisfactorily explained. Electricians, therefore, rightly consider that it is a good working theory, and they find it helpful in practice. Occasionally, however, certain phenomena arise which cannot be satisfactorily explained by the ordinary triangular diagrams, and it is necessary to go back and examine the assumptions on which these diagrams are based.

In the following notes a sketch is given of the elements of the mathematical theory of the synchronous motor and of alternators in parallel. The results are illustrated by means of curves so that their meaning can be read at once by the engineer. Although these results are in accordance with every-day experiment, yet great stress has been laid on the theoretical assumptions involved, as these sometimes explain the anomalous effects which worry electricians.

Consider the case of two alternating current machines running at the same speed, which are similar to one another in all respects, and suppose that they are connected together, one acting as a generator and the other as a motor. If we represent their E.M.Fs. by vectors, then if they differ in time lag by half a period they will be inclined to one another at an angle of 180°. If the excitations of the two machines be equal then the two E.M.Fs. will be equal, their resultant will therefore be zero, and there will be no current in the circuit. In order that power may be conveyed from one machine to the other there must be some current, and hence the vectors representing the E.M.Fs. must be inclined to one another at an angle.

The E.M.F. set up in the armature of an alternator is due to the conductors cutting lines of force. For our purpose it is convenient to divide these lines of force into two sets. One set is due to the resultant of the magneto-motive force of the current in the exciting coils, and of the current in the armature acting on the field magnets. The E.M.F. set up by the armature cutting these lines we will call the machine E.M.F. The other lines of force are only linked with the armature and are what Steinmetz calls the magnetic flux due to armature self-inductance. In some alternators the M.M.F. set up in the field magnet coils by the armature current is very small, and in this case we can consider that to a first approximation the machine E.M.F. depends only on the exciting current. In other cases this assumption is inadmissible. It can be shown that with a leading current the effect of the armature reaction is to increase the number of lines of force in the field magnets and thus increase the machine E.M.F. On the other hand, a lagging current tends to demagnetise the field magnets.* With a motor a leading current would tend to demagnetise the field magnets, and a lagging current would strengthen the magnetism.

In fig. 1 let O C represent the machine E.M.F. of the generator (E_1) and O A the E.M.F. of the motor (E_2). Join A C and bisect it in B, then twice O B represents the resultant of E_1 and E_2 in magnitude and direction, and is the E.M.F. that drives the current round the circuit.

* "Polyphase Electric Currents," S. P. Thompson, p. 35 (second edition).

Since E_1 is equivalent to the vectors O B and B C, and E_2 to O B and B A, it follows that B A and B C are each equal to the voltage V between the connecting mains.

Formula for the Voltage between the Bus Bars.

If V be the P.D. between the bus bars and θ the angle of phase difference between the E.M.Fs. of the two machines, then

$$V = \tfrac{1}{2}\{E_1^2 + E_2^2 - 2\,E_1\,E_2\cos\theta\}^{\frac{1}{2}}. \qquad (1)$$

The maximum value of V is therefore $\frac{1}{2}(E_1 + E_2)$, and it has this value when $\cos\theta = -1$, *i.e.*, when the phase difference between the two E.M.Fs. is 180°. In this case the two machines are acting in parallel so far as an external circuit connecting the bus bars is concerned. Hence, when two alternators whose E.M.Fs. on open circuit

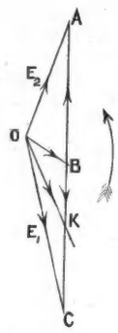


Fig. 1.

are E_1 and E_2 are joined together, the P.D. between the connecting mains is generally less than $\frac{1}{2}(E_1 + E_2)$. If the machines give E.M.F. waves of different shapes then θ can never be as great as 180°.*

Numerical Examples.

1. If the generator give a sine curve wave of E.M.F. whose effective value is 1,000 volts, and the motor gives a triangular wave of the same effective value, then, if the impedance of the armature of each machine is the same, the greatest value of V is 998·3.

2. If the generator produces a sine curve wave, and the motor a rectangular wave, or *vice versâ*, the effective value of the volts in each case being 1,000, then the maximum value of V is 974·8.

How the Driving E.M.F. in the Circuit varies with the Lag between the two Machines.

The effective value of the E.M.F. producing the current in the circuit is represented in magnitude by twice O B, and in phase by O B (fig. 1). This, however, tells us nothing about the shape of the resultant wave. The extraordinary way in which the shape of the resultant wave alters as the two machines get out of phase is not fully appreciated by engineers. It varies even when the two machines are exactly similar to one another, provided the E.M.F. waves are not exact sine curves.

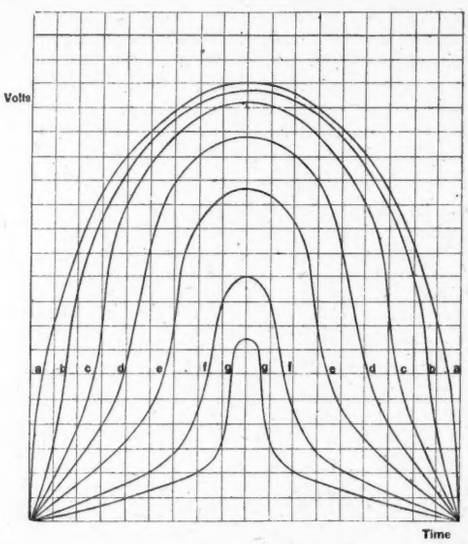
In fig. 2 the variation in the shape of the resultant of two exactly similar rounded E.M.F. waves is shown for the case of time lags of 15°, 30°, 60°, 90°, 120°, and 150° respectively. It will be seen that when the time lag is small we get a rounded wave, but when it is nearly 180° we get a very peaky one. The resultant of two peaky waves acts differently. When the time lag is small we get a peaky resultant, and when nearly 180° a very flattened wave. This change of shape of the driving wave of E.M.F. makes the angle of phase difference between it and the current produced a variable quantity. It is therefore a somewhat serious assumption to make that the impedance of the circuit of the two armatures is a constant. The reactance is also a variable quantity for another reason. In most alternators the reluctance of the magnetic circuit of the exciting coils depends on the position of the armature, and hence the shape of the machine E.M.Fs. must depend on the phase of the current.

* "Theory of the Power Factor," *Electrician*, Vol. 44, p. 49, or *Science Abstracts*, 1901, p. 198.

Distortion of wave shape with load is caused by the machine E.M.Fs. not being exact sine curves and also by armature reaction.

The Vector Representing the Current in the Circuit.

If the circuit of the armatures of the alternator and the synchronous motor were non-inductive than the current vector would be represented in phase by O B (fig. 1). In general, however, the phase difference between the current and the E.M.F. is appreciable. Suppose that O K (fig. 1) represents this vector, and let the angle B O K equal γ, then if, following Mr. Steinmetz, we suppose that O K is in the plane O A C, the angle K O A would be the angle of phase difference between the current and the motor E.M.F., and the angle



Resultant of two rounded E.M.F. waves when their time lags are (a) 0°, (b) 15°, (c) 30°, (d) 60°, (e) 90°, (f) 120°, (g) 150°.

Fig. 2.

K O C would be the angle of phase difference between the current and the generator E.M.F. This would be true, if the waves which O A, O C, and O K, represent were all sine curves, and in a few other very special cases. In practice it is not true, and hence we ought to have recourse to solid geometry in order to construct a graphical theory.* For simplicity, however, we will make the assumption that they are in the same plane, and remember that we have sometimes to discount our results in practice.

The Impedance of the Circuit of the two Armatures.

Owing to the shape of the resultant wave of E.M.F. round the circuit varying with the phase differences between the E.M.Fs. of the alternator and the motor, and owing also to armature reaction, the impedance is a variable.

Fundamental Formulæ for the Electrical Power Generated and for the Power given to the Motor.

In fig. 1, O C = vector E.M.F. of alternator = E_1
O A = vector E.M.F. of motor = E_2
O K = the vector representing the current.
A O C = the phase difference between O A and O C = θ.
B O K = γ = the angle of lag of the current behind the driving E.M.F., which is represented by twice O B.

Let I be the impedance of the circuit of the two armatures,
W_1 be the electrical power generated by the alternator,
and W_2 be the power given to the motor.

$$W_1 = E_1\,C\cos K\,O\,C$$

$$= \frac{E_1}{I}\,[E_1\cos\gamma + E_2\cos(\theta - \gamma)]. \qquad (2)$$

$$W_2 = -\,E_2\,C\cos A\,O\,K$$

$$= -\,\frac{E_2}{I}\,[E_2\cos\gamma + E_1\cos(\theta + \gamma)]. \qquad (3)$$

* "The Vector Properties of Alternating Currents and other periodic quantities," by Dr. W. E. Sumpner. *Proc. Royal Society.* Vol. 61, p. 465.

When the running is steady, equations (2) and (3) give us the relations between the various quantities involved. It is easy to show from (3) that the maximum value of θ is $\pi - \gamma$, and that the maximum value of W_2 is $\frac{E_2}{I}(E_1 - E_2 \cos \gamma)$. Hence the smaller the impedance of the circuit the greater the work the motor can do. It can also be shown that for a given load on the motor the machines will run in stable equilibrium, when $\theta = \pi - \gamma + \alpha$, where

$$\cos \alpha = \frac{W_2 I}{E_1 E_2} + \frac{E_2}{E_1} \cos \gamma \qquad (4)$$

When $\theta = \pi - \gamma - \alpha$ equations (3) and (4) are still satisfied, but the equilibrium is unstable.

If E_1 be great compared to E_2, α may be greater than γ and hence θ may be greater than π. The generator in this case may be regarded as the leading machine.

(To be continued.)

FOUR MOTORS v. TWO.

[COMMUNICATED.]

THE question of how much power to put under a car, and how to distribute that power, has not appeared as yet to have exercised our minds in England to any great extent. Hitherto we have bought all our equipments, including trucks, from the States, and practically we have done as we were told in the matter of horse-power.

Road after road has been started, and each one has followed its leader.

Quite recently it was hard to find any electric road running long double-bogie cars, although it had been common practice on the displaced steam lines. Somebody from America had said that short single-truck cars were used over there, so only short cars were ordered, without any consideration of what the service would require, or of what the manufacturers could do.

In the same way the 15-H.P. motor was supposed to be standard in the States, so it has been specified for almost every car in the kingdom, regardless of grades and other conditions.

The consequence is that when we travel uphill on an electric car we do it at from four to six miles per hour, thereby lowering the average speed even more than the usual Board of Trade regulations for the line compel, unless we race downhill against all regulations to raise it again.

Before cars are ordered for any line, the local conditions should be studied most carefully, and the probable requirements worked out.

It is not necessary merely to run cars, but to run them to the best advantage from the points of view of (1) the public, (2) the traffic manager, (3) the engineer; or the purse, the pocket, and the power-house.

Now, the points of view of the public and the traffic manager should be one and the same, if the road is to be operated successfully. The public want to be taken from point to point as quickly and as comfortably as possible, and it is the business of the manager to see that this is done. The engineer desires to see his plant running with a good load factor, but not dangerously overloaded by the maximum demand; and they all desire to keep down expenses—the public by getting the fares reduced, the manager by reducing running expenses, and the engineer by decreasing the cost of generation and maintenance of car equipments. Unfortunately, we take an unconscionably long time to change any of our methods, and we are too slow in discovering, or appreciating, perhaps, what other people have done to secure economy.

In America (how sick we get of the word!) street railway men have been experimenting and debating for several years on the question of the advantages to be gained by putting four motors under long cars. The long cars themselves have been accepted for some time, but there has been considerable controversy as to the motoring of these cars.

At the Kansas Convention last year, Col. N. H. Heft read a paper in which he expressed his conviction that four motors were better than two in every case, and he based his conviction on tests extending over three years. In the discussion which followed, the majority of the speakers were in favour of the four motors.

In the *Street Railway Journal* for May are printed two papers on the power consumption of two and four-motor cars, read before the New England Street Railway Club in February.

The first paper, by Mr. Pestell, E.E., of the Lynn and Boston Railway Company, shows that when identical motors are used in both cases, the power consumption of the four-motor equipment is about 20 per cent. greater than the two-motor equipment; but when four 37-H.P. motors were pitted against two 52-H.P. motors, there was very little difference in the power consumed per car-mile. The temperature of the two-motor equipment passed 100° C. in seven hours, being a rise of 94° C., while the rise in the four-motor equipment was only 66° C. in 11 hours.

In the tests quoted in this paper, all cars were of the same length, and the tests were taken while the cars were running in service, so we may assume that the conditions were equal, though nothing is said about the state of the rail, or whether the cars had been overhauled about the same time prior to the tests.

Mr. Bigelow stated in his paper that four-motor cars would not suit his lines (Boston Elevated Company), but he was very particular to say that that was no reason why they should not be the best for lines running under other conditions. Increased acceleration and running speed is the great advantage of four motors, and Mr. Bigelow said that this advantage would be useless to him, as the time now made is as fast as is allowed.

One of his tests showed that the four-motor car took 68 per cent. of the time required by the two-motor car to accelerate to 15 miles per hour, taking 64 per cent. more current to do it, but using this current for so much shorter time, that the extra energy required was 12 per cent. only. Other tests were not quite so favourable as this one.

Both papers are unsatisfactory from the fact that the details of the tests are not full enough. For instance, we should have liked to know not only the kilowatt-hours per car-mile, but the maximum current during acceleration.

Then Mr. Pestell does not indicate clearly how the four motors were connected on the several notches of the controller, and this point must have a very important bearing on results.

Mr. Bigelow states that he connected his four motors to a K10 controller, so that they were never all in series, but we presume that on the parallel notches they were all in parallel.

It seems to us that, if four motors are to be tried against two, special controllers should be used by which the connections pass from four motors in series to two series of two in parallel, and finally to four in parallel. In this way the starting current ought not to be much greater than with two motors, and less energy would be wasted in resistances.

Let us consider what we are going to gain or lose by selling our short cars, and buying double-truck cars with eight equal wheels and four motors, or perhaps maximum traction trucks with two comparatively powerful motors.

Our chief gain is greatly increased acceleration, and a speed on up grades which approximates to the speed allowed on the level. Taking a line five miles long with a 10 minutes' service, 100 minutes being allowed for the round trip, you have to run 10 cars. If you increase the acceleration after each of the many stops made in an urban service, and increase the speed on hills, it is safe to say that the 10 minutes' service could be kept up with nine cars. This one car off the road will go some way towards reducing the demand on the generating plant to what it was when the two-motor cars were used; running expenses will be lightened by the wages of a driver and conductor, and one car less will have to be bought and maintained.

Col. Heft asserted that consumption of power is actually less with four motors than with two, and he called the Westinghouse and General Electric Companies to bear out his statement. Nobody appeared to believe him, but it seems that Col. Heft took care not to have his motors too large, and to use a special controller. If these precautions

were taken, his results do not appear to be impossible. It cannot be denied that we treat our two-motor equipments badly. We bake them on hilly roads. We get double-decked cars, and we put under them the same motors that we use on single-deck cars.

The average efficiency comes out fairly high, but the cost of repairs is heavy.

It will be better to use double-truck cars, which will ride easily on any road, risk some extra power consumption, and give the motors a longer life. The cost of re-winding an armature would pay for many units. Failure of motors on the road means lost mileage, which means lost revenue, so that if we can use four motors that will keep cool, and run more miles per day than with the two motors, we shall increase the receipts and decrease running and maintenance charges.

It is difficult to understand the craze for maximum traction trucks (craze and trucks imported), unless one takes it as a token of shivering uncertainty; of timidity, in fact. It can be only a compromise between the four-wheel two-motor truck, and the double truck with four motors. If the high-power consumption of the four-motor equipment is feared, why not have two motors on two trucks with equal wheels and the idle wheels coupled to the drivers?

With the grades encountered on so many English roads it does not seem wise to throw away an ounce of traction.

It is really very difficult to see how the maintenance of a four-motor equipment, outside the motors themselves, can be no more expensive than that of a two-motor equipment. Gears, armature and axle bearings have to be renewed after a certain mileage, whatever the equipment, so that the maintenance of these parts must be twice as heavy for the four motors. We take it, therefore, that when Colonel Heft and others referred to maintenance charges the motors only were taken into account, and, of course, they are the most costly part of an equipment. There is no doubt, however, that short cars on indifferent track depreciate very much quicker, and cost more to keep in order, than would long cars on the same track. This is true, of course, whether the bogies are "maximum traction" or equal wheeled.

Even if it is found that 20 per cent. more power is used by the four motors, is that a sufficient reason for sticking to the old type? The cost of power is one of the smallest items in the total cost per car-mile, and if it is raised by the same percentage by which the output is increased (an unlikely thing), it will be more than balanced by the increased revenue resulting from quicker service, which must bring with it decreased running expenses if not increased receipts per car-mile.

On a greasy rail, or a rail covered with snow, four driven axles have an advantage over two, the slipping at starting and while running being less.

The curves given by Mr. Pestell show (if our deductions are accurate) that the two-motor car ran 56·61 miles in 5·75 hours, averaging 9·8 miles per hour, while the two curves given for the four-motor cars give these cars an average speed of 11 and 11·1 miles per hour, or nearly 11 per cent. increase.

Everything points to the ideal long car with two trucks of short wheel base and equal wheels with a motor to each pair, the motor being designed especially for the duty, *i.e.*, it will not be so large that it is running for the greater part of the time on the uptake of its characteristic, and it will not be so small as to be chronically baking its insulation. These remarks apply in the main to systems which include heavy and long grades, and not to the exceptional systems which are blessed with straight and easy roads; at least, if the latter are not of any considerable length.

PARLIAMENTARY COMMITTEES.

Yorkshire Electric Power Bill.

On the Committee resuming on 21st inst., Mr. Pember, K.C., said that on behalf of the promoters, he was willing to be put under an obligation to avoid certain roads in the case of Bradford, Leeds and Sheffield. He thought these great towns ought not to be permitted to stand in the way of the perfect and best use of a scheme of this kind. At the same time there ought to be as little interference with the streets of these cities as possible. An arrangement of this kind had been entered into between the promoters and the corporations of Barnsley, Huddersfield and Halifax.

The Chairman said they could leave the question and see if an arrangement could be arrived at. If not they would have to decide the question of wayleaves. The question of canals and railways might remain an open one for the present. The general question remained whether the company would be allowed to supply the railway and canals within the areas of Sheffield, Bradford and Leeds.

Mr. Geo. Gibb, general manager of the North-Eastern Railway, having given evidence in support of the Bill,

Prof. Silvanus Thompson, F.R.S., Past-President of the Institute of Electrical Engineers, in reply to counsel, said he was of opinion that the area of supply was admirably planned and the generating stations were well placed, while the estimates for the work were sufficient. As to wayleaves, an enterprise of that kind ought not to be hampered by having thrown upon it an unnecessary capital expenditure—which would compel the promoters to go a long way round a town. He thought that a densely-populated and busy district should be avoided, and he would leave the actual route to arbitration, and the clause in the Bill to that effect was entirely reasonable.

The Chairman: Do you see any objection to binding yourself not to go into the centre of the towns, as I understand was done in the case of Huddersfield?

Witness: I see no objection.

Mr. Claude Baggallay, K.C., said the promoters were quite prepared to leave what he might call an "island" in the centre of Leeds and Bradford into which the mains should not go.

The Chairman: Would you do the same thing in the case of Sheffield?

Mr. Baggallay: I know of no reason why it should not apply to Sheffield also.

Replying to Mr. Gerald Fitzgerald, the Witness said he was unable to say what the demands of the future would be, or the number of mains and size of them. The company could conveniently run their mains to the east of the Midland Railway. In that case it would not be convenient to go outside Sheffield altogether. The road to his mind was in the southern part of the city, near the Midland Railway, a few yards to the eastward. The mains would come along the Chesterfield Road—there was hardly any population till coming within a few yards of the border. Then there would be a diversion towards the east, going not very far from Norfolk Park, avoiding the population between the Midland Railway and the drill ground, going somewhere near White's Lane, and keeping generally to the east of the part where the houses are, passing near Nunnery Colliery and the Sheffield Canal.

Mr. Fitzgerald: You will take the usual period of five years to complete your works?—I suppose so.

Have you got any idea as to when you will be able to come to Sheffield?—About two years.

By that time Sheffield will have been in possession of an electric undertaking for five years?—Yes.

Reverse the positions—supposing you had been in possession five years, would you not think it hard if the Corporation were to try and bring in a Bill to take two of your best customers away?—I do not think it would be hard, it would depend on the price.

The case for the promoters then closed, and Mr. Balfour Browne, K.C., addressed the Committee on behalf of the Corporation of Bradford.

At a further sitting of the Select Committee under Sir William Houldsworth, to consider this Bill, Mr. Robert Hammond, of London, was called on behalf of the opposing boroughs of Leeds, Sheffield, and Bradford, and expressed the opinion that the wayleaves asked by the promoters through these boroughs were unnecessary. With respect to the figures given by the promoters, he understood that £680,000 was to be spent outside the works on distribution, and that out of that sum transformers were to be provided. He thought the transformers a very heavy obligation, for the promoters had not only to transform the voltage, but to make it continuous. He took it that about £200,000 would be left for mains, yet Leeds had spent £161,000 on mains, and had not got them everywhere, while Sheffield had spent £133,000 on mains. In his opinion, the promoters had under-estimated the costs of distribution. He considered that the boroughs like Leeds could supply more cheaply than a company at a distance. He thought the question of the supply of electricity to railways was one of public policy.

Questioned by the Chairman as to whether he thought if the Corporation could supply more advantageously the railways would come to them, Witness said what the boroughs were afraid of was being squeezed out by unfair competition.

In further examination, Witness said that Sheffield was doing its utmost to bring its electrical undertaking up to a high state of efficiency. The Corporation of Leeds were endeavouring with success to meet the latest developments in electrical science, and he had accompanied their engineer to France for the purpose of investigation.

Mr. Chattock, electrical engineer to the Corporation of Bradford, described the various steps which had been taken by the Corporation to make their electrical undertaking efficient, and expressed the opinion that with their extended powers Bradford would be able to meet all demands.

In cross-examination, Witness said the Bradford Corporation sold electricity to the Lancashire and Yorkshire Railway at 1d. per unit, and he could not admit that that resulted in a loss. He regarded the undertaking as a whole and averaged the profitable and unprofitable customers together.

Mr. J. H. Cox, city surveyor for Bradford, expressed the opinion

that it was an impracticable suggestion that the promoters should bring their mains within half a mile of the Bradford Town Hall. What Bradford wanted was to be treated in an exactly similar way to Liverpool and Manchester in the South Lancashire Power Bill, and be totally excluded from the operations of this Bill. They were prepared to give the promoters wayleaves at the extreme west and east of the borough.

Replying to the CHAIRMAN, WITNESS admitted that if the Committee refused wayleaves to the promoters for the county boroughs, it was quite possible that in course of time the boroughs would extend their boundaries, and that the protection which might be now given would prove no protection at all.

Mr. WATSON, the waterworks engineer to the city of Bradford, asked that in the event of the Committee allowing wayleaves, there should be an electrolysis clause.

Mr. FITZGERALD addressed the Committee on behalf of the Sheffield Corporation, and pointed out that in 1898 the Corporation acquired the undertaking of the Sheffield Electric Lighting and Power Company at a heavy expenditure, and subsequently they had spent considerable sums of money in perfecting the undertaking and making it efficient to meet all requirements. The Corporation were in the position to generate electricity at the minimum of cost. The promoters of the South Yorkshire Bill had agreed not to come inside Sheffield, and they asked that the same should apply to the Bill now before the Committee. They asked that, after spending so much money, the company should not be allowed to compete for the custom of two of their best customers, the railways and canal companies. If the promoters only wanted to join hands with the Derbyshire and Nottinghamshire Company, they could do it just as well by going through Handsworth and Rotherham, and could do so more cheaply. No attempt had been made to show that Sheffield had failed in its duty with reference to the supply of electricity, and consequently he asked that they should be excluded from the operations of the Bill.

Mr. S. E. FEDDEN, chief engineer of the electrical works of the Sheffield Corporation, gave evidence, and said that £400,000 had already been spent on the works, while there was a contemplated expenditure of another £600,000. They were changing their system to the polyphase alternating system, and would be able to cope with all demands that might be made for power by the manufacturers, and they would be in quite as good a position to supply as the promoters of the Bill. The charge now was 2d. per unit for power, with a reduction of 25 per cent. if a motor was used for 45 hours per week, and there would in the future be a further reduction. The Corporation had done all in their power to encourage the use of electricity in the city.

Mr. R. STYRING, the chairman of the Electric Lighting Committee of the Sheffield Corporation, stated that in 1898 the Corporation paid £299,323 for the undertaking of the Sheffield Electric Lighting and Power Company. Witness pointed out an alternative route which the company could take to join up with the Derbyshire and Nottingham Company. The pertinacity of the company in wishing to come through Sheffield made them suspicious.

At a sitting of the Committee on 23rd inst. evidence was given in opposition to the Bill on behalf of the Leeds Corporation.

Mr. H. DICKINSON, the chief engineer and manager of the electricity supply depôt at Leeds belonging to the Corporation, stated that they took the undertaking over from the House-to-House Electric Supply Company in the year 1898. They paid £388,000 for the works, and they had since spent an additional £170,000, and when they had completed their extension they would have spent a total of about £700,000. On behalf of the Corporation he wished to say that they objected to the Yorkshire Company laying mains through Leeds.

Mr. Alderman REGINALD WIGRAM, the chairman of the Electric Lighting Committee, gave similar evidence.

Mr. PEMBER, K.C., followed, and replied on behalf of the promoters, and said he submitted with all deference that he had shown expediency in the case, and that Parliament ought to give the promoters a wayleave through Sheffield, Bradford and Leeds. Many of them argued that municipal trading was questionable, but municipal trading plus monoply was intolerable. This question of wayleave was not a question of competition at all. It was merely a question of transit through a town. The principle of wayleaves had been established by Parliament, and was one of the recommendations of Lord Cross's Committee of representatives of both Houses of Parliament. He could not say which route he was going to take until he knew what demands would be made upon them for the current they wished to sell. Personally, he thought the right thing for the Committee to do was to give the wayleaves without regard to prohibited areas and leave the Board of Trade to decide whether a particular route proposed by the promoters through Sheffield, Bradford, and Leeds was a practicable one or not. If the promoters were to serve the public they should be allowed to get the wayleaves, but if not, they should be excluded, but he strongly submitted that the present Bill was in the public interest.

After consulting in private, the CHAIRMAN announced that the Committee had decided that the preamble of the Bill was proved. With regard to wayleaves, they would not exclude Bradford, Leeds, or Sheffield, but they desired to express the opinion that they would like to see a prohibited area in each of these places agreed upon in a clause to be brought up after the holidays. The reason they left it to agreement was because they felt that any definition that they might give might be open to objections, and it was very probable that the prohibited area might be arranged by agreement between the parties. If no agreement was arrived at in any of these cases, the Committee would be prepared to deal with it. With regard to the railways and canals, they passed the Bill as it stood. It was understood that Leeds, Sheffield and Bradford would be put in the third schedule, and covered by 40 B. With regard to Huddersfield and Barnsley, they did not know what had happened.

It was stated that so far as those places were concerned a settlement had been arrived at.

Mr. BAGGALLAY said Barnsley was a place where a prohibited area had been agreed upon.

It was stated that Halifax had been dealt with in a like manner.

Mr. BALFOUR BROWNE intimated on behalf of the county boroughs—Sheffield, Leeds and Bradford—that he had received instructions to say that the Corporations would withdraw from the inquiry altogether, and that they reserved themselves to oppose in the other House.

The Committee then decided to consider the question of prohibitive areas, and ordered the room to be cleared for that purpose.

On the reassembling of the public, the CHAIRMAN said that in the case of Huddersfield, Halifax and Barnsley, prohibitive areas had been agreed upon by the parties, and with regard to Sheffield, Leeds and Bradford, the Committee wanted from the promoters a clause undertaking that there should be a prohibitive area of a mile from whatever place they could suggest—either the Town Hall, or the cross, or the centre of the city. He hoped there would be no difficulty about the matter.

Mr. BAGGALLAY: There will be no difficulty.

Mr. FRERE: Parliamentary agent for the promoters pointed out that in Leeds and Sheffield it would be impracticabte to fix a mile radius, as the local conditions were peculiar.

Mr. BAGGALLAY: You mean something equivalent in area to the mile radius, but different in shape.

Mr. FRERE: Yes.

The CHAIRMAN intimated that the Committee wanted the promoters to bring up something in harmony with their decision. They did not confine them to details.

Mr. FRERE said that although their opponents had retired, he would send them a copy of the clause after they had drawn it up.

The Committee declined the application of the Corporation of Dewsbury to put an electrolysis clause in the Bill.

The Committee adjourned till Tuesday, June 11th.

ECCLES CORPORATION BILL.

ON 22nd inst. a Select Committee of the House of Commons, presided over by Mr. Heywood Johnstone, considered an omnibus Bill promoted by the Eccles Corporation, under which powers were sought to reconstruct existing tramways and make new ones, and to widen the streets. It is proposed that the tramways shall be run by the Salford Corporation.

Mr. RAM, K.C., who appeared for the promoters, explained that the tramways were now owned by the Eccles Corporation, and the proposal was to double the line which went to Manchester. He was prepared to adopt the overhead system for working the line, and there could be no doubt that the trams would be an advantage to the locality.

Mr. HICKSON, the town clerk of Eccles, gave particulars as to the tramways, which he said were laid down in 1877, and were leased to the Manchester Carriage and Tramways Company until the commencement of this year. The borough of Salford was to work the tramways, and was to pay interest on the capital expended by Eccles; the estimated cost of constructing the lines was £65,000.

The only opposition to the Bill was that of certain owners of property, and the Committee, after hearing evidence, passed the tramway part of the Bill.

WEST CUMBERLAND ELECTRIC TRAMWAYS BILL.

A LARGE tramway scheme contained in the West Cumberland Electric Tramways Bill occupied the consideration of Mr. Seale-Hayne's Committee of the House of Commons several days last week.

Mr. BALFOUR BROWNE, K.C., in opening the case for the promoters, said that a body of gentlemen proposed to form a company to construct the line, and the share capital would be £400,000 in shares and £100,000 borrowing powers. The tramway would be 31 miles in length, and would be worked by electricity. The company also took power to erect a generating station, from which they would be prepared to supply electricity for public and private purposes within certain limits. They also took powers to make roads and effect other small improvements in connection with the tramways. The tramway service would begin at Cleator Moor and end at Sillett. The gauge would be 4 ft. 8½ in., and the line would be divided for the convenience of the local authorities who might desire to purchase, into 17 separate tramways, and it would mostly run along the public road. It would serve 15 important villages and five important towns, containing altogether a population of 68,000 persons, and the whole district to be served had a population of 120,000. The estimate for the generating stations and works under the Bill amounted to £361,597, and the scheme had practically the unanimous support of the whole district, for the Cleator Moor Council were only opposing on one point.

Mr. F. KELLY, clerk to the Maryport Council and the Maryport Harbour Commissioners, gave evidence as to the need of further travelling facilities and to the unanimous support accorded the scheme by the people in the locality.

Mr. ALFRED FOWLER stated that he prepared the estimates for the scheme, and considered they were all well within the mark. The opposition of the Cleator Moor Council was in reference to the

to stand in the way of the perfect and best use of a scheme of this kind. At the same time there ought to be as little interference with

and unprofitable customers together.

Mr. J. H. Cox, city surveyor for Bradford, expressed the opinion

bridge at that place, which they wanted the company to widen. The width of the bridge now was 25 ft. 6 in., and he did not consider there was any necessity to widen it.

Several members of the Cumberland County Council were called, and stated that in their opinion there was no necessity to widen the bridge.

Mr. R. ROBERTS, surveyor to the Cleaton Moor Urban District Council, was called by Mr. WEDDERBURN with reference to the bridge, and contended that it was dangerous for the tramway company to monopolise all but 8 ft. of the bridge.

Other evidence of a like character having been heard,

The Committee decided that the preamble of the Bill was proved, and that there was no necessity to widen the bridge.

The Bill was ordered to be reported for third reading, but the question of what price the company should charge for electricity was ordered to be held over for the further consideration of the Board of Trade.

UNDERGROUND RAILWAYS.

AT the commencement of the sitting of the Joint Committee on the Underground Tube Bills, of this session under the chairmanship of Lord Windsor, on Friday,

Mr. FITZGERALD, on behalf of the London County Council, said that it had been asked that the report of the London County Council should be printed and circulated before the next sitting of the Committee. He had to state that there was no report, but the Council were prepared to give evidence, and that evidence would be ready by June 14th.

Lord KNUTSFORD said that all they wanted was to be furnished with a *précis* of the evidence to be given.

Mr. FITZGERALD said he would see that this should be done.

KING'S ROAD RAILWAY.—Mr. BALFOUR BROWNE, K.C., said that he appeared with Mr. Moon on behalf of the King's Road Railway, and he thought that he would be able to show that the proposed line would give great facilities to the public. The route commenced at Eel Brook Common, Fulham, and ran through a densely populated district of which King's Road was the main artery, and it finished at Victoria There was no railway opposition. He thought that Victoria was the most important centre of distribution in London, for they got into touch with more than half the railways in London. There was another important line which would be proposed at a later stage, which was the West and South London Junction Railway, and which we intended to run from Paddington to past the Oval on the south side of the Thames. This line crosses the King's Road Railway at Victoria Station, and an arrangement would be made to form an exchange station. Beyond the fact that they would interfere with the omnibuses, he did not know of any other opposition. He did not think they would compete with the District Railway, but they would rather act as a feeder to that line.

Mr. RADFORD LESLIE, M.I.C.E., said that he was in the office of Sir J. Wolfe Barry, and had assisted Mr. Arthur Barry, in connection with the line. They proposed having a station at the termini in Wandsworth Bridge Road, and one at Beaufort Street, Sloane Street, Manor Street and Victoria. He found that from inquiries made in 1886 by the London County Council 80 omnibuses passed along the King's Road per hour, and since then the number had largely increased. People living in Walham Green who wanted to go to Victoria had to go by omnibus or by the circuitous route by the District Railway through Earl's Court. The length of the proposed railway was two miles and six furlongs. At present it would take 20 minutes upon the District Railway, but it would not take longer than ten minutes on the new line. Arrangements would be made for an interchange station with the proposed West and South London Railway.

In answer to Lord KNUTSFORD, WITNESS said the size of the tunnel proposed was 11 feet 6 inches, and there would probably be a uniform charge for tickets. The question of having a larger tube since the Vibration Committee had sat had not been considered.

Questioned by Sir J. DICKSON-POYNDER, WITNESS said he believed that a good many omnibuses ran between Eel Brook Common and Putney, but the reason for their terminating at Eel Brook Common was because of the many important roads centring on that point.

In reply to Mr. ASHTON, WITNESS said that there would be communication between that railway, *viâ* the West and South London Junction Railway, with the District Railway at Victoria, so that passengers could get to the City.

By a MEMBER of the Committee: He thought he preferred that the line should be made under the street rather than under the houses in King's Road.

Mr. BALFOUR BROWNE: It would be cheaper.

Mr. BALFOUR, the surveyor to the Duke of Westminster, went into the witness box in opposition to the scheme, and said that property on the Grosvenor Estate had been injured by the construction of the Central London Railway. He attributed the injury done not so much to vibration as from the fact of the sub-soil being drained. That did not apply so much to the tunnel, which was constructed under great pressure, but in the construction of the stations.

Lord KNUTSFORD: We should have to give up constructing railways in London altogether then.

WITNESS said that his point was that they would construct a railway which would be inconvenient to the tenants of Grosvenor estate, and there would be no correspondent advantage to them.

Mr. BALFOUR BROWNE said with regard to the opposition, if it was blue clay there would be no necessity for pumping, and if gravel, then the work would be done under pressure. After all, what the Committee were considering then was the question of route.

PICCADILLY AND CITY RAILWAY.—Mr. BALFOUR BROWNE, K.C., next opened the case for the Piccadilly and City route, and said that it was a line with regard to which he need not call any local evidence. The line started from an end-on junction with the North-East London Railway at Cannon Street. Then it would go to Ludgate Circus and on from there to the Law Courts, where there would be subways; then to Wellington Street, Strand, where they would be able to make an interchange with the Great Northern and Strand Railway which was sanctioned two years ago. From Wellington Street they would go to Charing Cross, where there was to be a station, and then they proposed to go on and make an end-on junction with the Brompton and Piccadilly Railway. If the Brompton and Piccadilly Railway did not want to have that junction it would be possible for the promoters to get a through route to the West by joining up with the Hammersmith and Charing Cross line which was been promoted. That railway was anxious that this line should be joined up, but he was prepared to leave it to the Committee whether or not they should form a junction with the Brompton and Piccadilly Railway.

Sir DOUGLAS FOX, engineer to the scheme, said the line was a prolongation of the proposed North-East London Railway, and was promoted by the same persons. The directors of the two companies felt that it was necessary in dealing with so expensive a piece of line as the Piccadilly Circus, that there should be some through route in order to make the traffic a fairly paying one. The first station would be at Cannon Street, and they would carry the line along Carter Lane so that there should be no interference with St. Paul's Cathedral. The second station would be at Ludgate Circus, where they would give facilities to the public by putting stairs on the two sides of the road. The third station would be the Law Courts station, and they were now discussing with the authorities the question of putting in a subway from the railway to the Law Courts, and also a subway from the Law Courts to the Temple. The fourth station would be at Wellington Street, where they would interchange with the Great Northern and Strand Railway, which had been authorised, and there would also be a station at Lowther Arcade, where they would join up with the Baker Street and Waterloo Railway, and hence would go on to Piccadilly Circus.

The CHAIRMAN asked if witness was going to press for the end-on junction with the Brompton and Piccadilly Railway, for if he was not it seemed no good going into that matter.

Mr. BALFOUR BROWNE said the position was that Sir Douglas Fox thought there ought to be an end-on junction with the Brompton and Piccadilly Railway, but if the Committee would not allow it, then then they would make a junction with the Hammersmith line.

After some discussion between counsel, the point was not gone into further.

WITNESS, continuing, said that, under any circumstances, they would require a station at Piccadilly Circus. They preferred to work with the Brompton and Piccadilly Railway if that company would work with them, but if not, they could go to the other.

Replying to Lord KNUTSFORD, the WITNESS said they asked for powers to construct a 13 ft. 6 in. tube, but the idea was not to exceed 13 ft. The Hammersmith and Charing Cross line proposed to take the same powers. He thought it had been clearly shown that, for through traffic, there must be a 13-ft. tube.

Replying to Mr. LANCASTER, WITNESS said there would be no difficulty in making an end-on junction with the Charing Cross and Hammersmith Railway.

No further evidence was taken in support of this Bill.

SOUTH AND WEST LONDON JUNCTION RAILWAY.—Mr. BALFOUR BROWNE next opened the case of the South and West London Junction Railway, which he said consisted of four sections. The first one was from Bishop's Road, north of Paddington Station, and terminated at Marble Arch. No. 2 began at Marble Arch, and ran down to Victoria, and with regard to that section, he might say that they had made arrangements to carry it under the Park instead of going under Park Lane. No. 3 would be from Victoria to Vauxhall, and No. 4 would run under the river, past the Oval and terminate in the Camberwell New Road. At Paddington it was proposed to have a subway to connect them with the Great Western Railway, and at Victoria they would have an interchange station with the King's Road line, and by subways would be able to reach the District and London and Brighton Railways. The route was a most important one, and he understood that the Metropolitan Railway Company and the District Railway Company would seriously oppose it on the ground of competition, and there was no doubt it would be a competition. He might mention that they would be able to have an interchange station at the Marble Arch with the line which had been authorised to go from the Marble Arch to Cricklewood. At first the company had proposed to have their generating station at Paddington, but in consequence of the opposition of the Paddington Borough Council they now proposed to make their generating station at Camberwell New Road, and schedule land for the purpose. Singularly enough, the City and Brixton Railway Company had also scheduled the same piece of land, but their Bill was not before that Committee.

Mr. ARTHUR JOHN BARRY, partner in the firm of Sir J. Wolfe Barry, engineer for the line, described the route in detail, and said that with the proposed new tube railways this line would have connections with 17 different railways.

Mr. BAGGALLAY cross-examined Witness for the purpose of showing that the line was one which would be one of practical convenience to the public.

Sir DOUGLAS FOX, on behalf of the North-West London line, objected to the proposed line crossing under that company's line

near the Marble Arch, although they were willing to allow an end-on junction.

The Committee adjourned till June 11th.

ELECTRIC LIGHTING PROVISIONAL ORDERS.

THE Electric Light Provisional Orders, Nos. 2, 3, 4 and 5, came before Mr. Lowther, the chairman of Ways and Means of the House of Commons, on 23rd inst., as unopposed measures and were ordered to go forward.

No. 2 Bill confirmed provisional orders to the following authorities:—

Abertillery Urban District Council, in the County of Monmouth.
Aspull Urban District Council, in the County of Lancaster.
Britton Ferry Urban District Council, in the County of Glamorgan.
Cannock Urban District Council, in the County of Stafford.
Ebbw Vale Urban District Council, in the Counties of Monmouth and Brecon.
Faversham Corporation, in the County of Kent.
Llandaff and Dinas Powis Rural District Council, in the County of Glamorgan.
Llangollen Urban District Council, in the County of Denbigh.
Neath Corporation, in the County of Glamorgan.
Tredegar Urban District Council, in the Counties of Monmouth and Brecon.

The Confirmation Bills for Provisional Orders 3 and 4 were also passed. Particulars were given in the ELECTRICAL REVIEW of May 17th of these Bills. They referred to the local authorities of Birstall, Cheshunt, Hindley, Honley, Standish-with-Langtree, Stratford-upon-Avon, Dorchester, Felling, Frome, Lichfield, Mitcham, New Hunstanton, Northfleet, Skipton, Atherton, Benwell and Fenham, Beverley, Chesham, and the Isle of Wight Electric Light and Power Company.

The Confirmation Bill for Provisional Order No. 5 dealt with the following Bills:—

Macclesfield Corporation, in the County of Chester.
Ripon Corporation, in the West Riding of York.
Todmorden Corporation in the West Riding of York.
Trowbridge Urban District Council in the County of Wilts.
Ware Urban District Council in the County of Hertford.
Wellingborough Urban District Council in the County of Northampton.
Wellington Urban District Council in the County of Salop.
Widnes Corporation in the County of Lancaster.
Wisbech Corporation in the County of Cambridge.
Workington Corporation in the County of Cumberland.

BLACKBURN CORPORATION BILL.

THE Omnibus Bill of the Blackburn Corporation came before Mr. Lowther, the Chairman of Ways and Means, in the House of Commons on 23rd inst., as an unopposed measure, and was ordered to be reported for third reading. The Bill gives power to reconstruct about five miles of existing tramways and construct between three and four miles of new tramways. Power is also taken to obtain running powers over the Blackburn, Whalley and Padiham Light Railway Company's line, and to grant the company running powers over the Blackburn lines, and also to purchase the company's lines in Rishton, should it become insolvent. The estimated cost of the tramway works under the Bill is £152,000.

LITTLEBOROUGH TRAMWAYS.

PROOF of compliance with Standing Orders has been given before the Examiner of the House of Lords in respect of the Order authorising the Littleborough Urban District Council to construct tramways within the Council's area. The tramways scheduled are respectively 1 mile 1 furlong 0·70 chain, and 1 mile 5 furlongs 1·83 chains in length.

MIDDLETON AND CHADDERTON TRAMWAYS.

THE Tramways Confirmation Order Bill has passed the Examiner of the House of Lords in respect to compliance with standing orders. The Bill authorises the Corporation of Middleton and the Urban District Council of Chadderton in the County of Lancaster, to construct tramways within the Borough and Urban District.

HYDE TRAMWAYS.

THE Examiners of Standing Orders in the House of Lords have found the Orders of the House complied with in regard to the Tramways Confirmation Order, under which power is given to the Hyde Corporation to construct certain tramways within the borough. The Bill contains clauses for the protection of the Oldham, Ashton and Hyde Electric Tramways, Limited.

MANCHESTER CORPORATION BILL.

ON 22nd inst. the Examiners of Standing Orders in the House of Commons found that the Orders of the House had been complied with by the promoters of the Manchester Corporation Bill, which authorises the Corporation amongst other matters to make various tramway extensions. The Bill, which has already passed the House of Lords, will now go to the House of Commons for second reading.

NOTTING HILL ELECTRIC LIGHTING COMPANY.

THE Bill of the Notting Hill Electric Lighting Company came before the Chairman of Committee of Ways and Means of the House of Commons on the 23rd inst. as an unopposed measure, and was ordered to be reported for third reading. The Bill authorises the company to take certain lands and buildings situated in the parish of St. Mary Abbotts, Kensington, known as No. 14, Napier Road, with the nursery gardens in the rear, and certain other lands, houses and stables in the same parish known as Nos. 9, 10 and 11, Holland Mews, and to erect and work a generating station on such lands.

CHEBETON TRAMWAYS.

THE Tramways Confirmation Order (No. 3) came before the Examiner of the House of Lords on 22nd inst. Powers are given under it for the Cheriton Urban District Council to construct several small lengths of tramway within the Council's area. The Bill was committed for second reading.

COLCHESTER TRAMWAYS.

THE Tramways Confirmation Order Bill referring to the Corporation of Colchester, passed the Examiner of the House of Lords, and will go to second reading. Powers are asked to construct four lengths of tramways, No. 1 being 1 mile 7·43 chains in length; No. 2, 1 mile 1 furlong 8·48 chains; No. 3, 5 furlongs 1·82 chains No. 4, 2 miles and 3·26 chains.

LEGAL.

THE RIVER PLATE CONSTRUCTION COMPANY, LIMITED, JAMES CAPEL & CO., AND CHAS. BRIGHT.

MR. CHAS. BRIGHT appealed from the order of Mr. Justice Farwell, to the Court of Appeal on 22nd and 23rd inst., and argued his appeal in person.

The appeal was dismissed with costs.

CORRESPONDENCE.

The British Press and British Industry.

Being closely connected with one of the chief manufacturers in this country, and having had frequent occasion to inquiry into the reasons why preference is continually being given to foreign-made machinery, I should like to corroborate the statements contained in your article of the 10th inst., under the above heading, and to disagree with Mr. T. W. Sheffield's letter in your issue of the 24th inst.

Speaking generally, there is very little favour shown towards the manufacturers of this country, and at the present time I am not far wrong in saying that there is a distinct inclination in favour of foreign-made machinery among the managers and engineers of private firms, iron and steel works, shipyards, &c., all of them large buyers of electrical plant.

The same remarks apply to the public generally, but in their case the municipalities have greater difficulty in showing this preference.

In my opinion, this is largely due to the influence of the British press, who have assumed, and have succeeded in grafting into the public mind, that the electrical manufactures of other countries exceed in excellence those of our own. Consequently, when tenders for foreign-made machinery are compared with tenders for home-made manufactures, provided the price of the former does not considerably exceed that of the latter, there is a secret feeling of preference shown towards accepting the tender for the foreign-made machinery.

In fact, it is to my knowledge that, in some cases, tenderers for foreign-made machinery have been asked to lower prices and to accept the contract at the price of the British tender for manufactures which have been made in this country for upwards of 20 years!

This has not been done in any unfair spirit, but simply through a firm conviction on the part of the buyer—a conviction for which British journalism is largely responsible, that our manufacturers have not had the experience that foreign manufacturers have had, and that they were getting better value by purchasing machines made out of England.

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I have referred above to the question of price of foreign made machinery when competing with our own manufactures; as a matter of fact, machine for machine the one of foreign make ought to be quoted considerably lower than the one of British make, and I do not say this for commercial reasons, but anyone that has examined the working drawings, dimensions and weights of two machines of similar output, the one foreign made and the other British made, must have satisfied himself of the greater cost entailed in producing the more substantially built machines which most of our manufacturers consider necessary to stand the test of time.

In spite of this, however, the majority of works engineers in this country, who are purchasers of plant, cannot be made to believe that the lighter built machines must be less costly than the more substantially built ones, and for the very reasons referred to above, that they have been led to believe that the manufacturers in this country are behind hand, and have not had the experience, and consequently differences of this description are ascribed to the ignorance in manufacture on the part of the home producer. If makers in this country are behind hand, it does not appear in the excellence of the machine when completed, as Mr. Sheffield assumes, nor yet to the fact that they have but tardily taken up the manufacture of multiphase machinery, as to the future of which there are, to say the least, differences of opinion, but rather that for commercial reasons they have lagged behind in not keeping their supply up to the demand.

If the British press had produced the feeling of regret at having temporarily to purchase abroad due to British manufacturers being unable to deal with the work within the time permissible, and had encouraged a flow of capital into the industry to get over this trouble, there would have been little to complain about, but the effect aimed at has been to show that our manufactures have not been equal to the productions of America and the Continent.

Few will agree that this is the case.

E. J. F.

London, *May 27th*, 1901.

Personal.

In writing to thank you for your recent kindly notice of our engineering supplement, *Traction and Transmission*, will you allow us to say that the extract you make from the *Street Railway Journal* contains a quite erroneous statement which we will ask you to correct in an early issue.

Mr. Philip Dawson's connection with *Traction and Transmission* is that of a frequent and valued contributor; he is not its editor, as stated by our trans-Atlantic contemporary.

The Editors of "Engineering."

Electric Blowing at Lincoln Cathedral.

With reference to Mr. A. Bergtheil's letter on above in your last issue, it is perfectly true, as he states, that the power necessary was in the first place over-estimated by the organ builders. It is also true, however, that Messrs. Bergtheil & Young were asked to make some alteration on account of this to reduce the power. This they did by replacing one of the motors by one of a smaller size and altering one or two pulleys, &c. This was completed, and the installation left by them as finally finished in December, 1899.

It was soon found the apparatus was not satisfactory. In order to keep it running at all, it was necessary for someone to be constantly in attendance, and even then it sometimes broke down; moreover, it failed to give a sufficient supply of wind for those parts of the service in which a heavy demand is made on the bellows, the effect being often "wobbly" and unsatisfactory, and it was on this account impossible to sustain heavy chords on the full organ for any length of time.

Messrs. Bergtheil & Young were informed of this state of things, and a long correspondence took place with them about it, and every opportunity was given them of putting it right, numerous tests, drawings and plans being made for them by us for the purpose. However, the only result was that they sent in a large estimate for doing the work, whereupon it was decided to do the work locally, and Messrs. Bergtheil & Young wrote the letter we have formerly quoted giving up all responsibility.

Since then we have made a complete rearrangement of the plant, with the result that although only two motors are now used instead of three, there is an ample supply of wind, and it requires little attention.

Under these circumstances we were rather suprised to see Messrs. Bergtheil & Young's announcement in your issue of May 3rd, 1901, that "the contract and all responsibility in connection therewith was placed with them, and has remained with them ever since."

We may add that this letter has been shown to Dr. G. J. Bennett, organist of the cathedral, and he entirely agrees with the above statements about the supply of wind, &c.

F. H. Hutton.
H. Mantle.

Lincoln, *May 26th*, 1901.

Mercury Vapour Lamps.

In reading your article in this week's issue of your paper, I was much interested in the description given of mercury vapour lamps. This class of lamp, though more or less tentative in the present stage, is very probably the preliminary step towards what is greatly desired, namely, an economical electric lamp which does not waste most of the energy supplied to it in heat, but would be capable of converting electric current vibrations into those of light, through the medium of a highly attenuated gas or metallic vapour, the gas or vapour having to possess possibly a certain critical point of attenuation, so as to be capable of vibrating at the enormously high speed required. I should like to suggest the following experimental lamp to anyone who may have facilities for carrying it out, which might form the basis for, eventually, a practical one:—

An exhausted glass bulb, the same shape as an ordinary incandescent lamp bulb, with similar contacts in the top as an ordinary lamp, with two carbon or iron electrodes extending about two-thirds down the inside of the bulb, sealed in with platinum wire in the usual manner. This glass bulb has a cylindrical prolongation at its lower end, to contain a little mercury, and is surrounded by a platinum (or other metal) heating coil.

This coil would be in parallel with the terminals of the electrodes of the lamp, and, of course, of a suitable resistance.

On the mercury being vapourised by the heating coil, the light would be produced between the electrodes in the bulb, and an additional source of light might be produced by the condensation of the mercury on the cool parts of the bulb, globules of which would roll down to the bottom to be re-vapourised (as shown in Mr. Legh S. Powell's experiment). Presumably, the E.M.F. required would be between 40—60 volts.

J. Palmer, I.M.S.R.E.

The Location of New Electrical Works.

I thoroughly agree with my friend Mr. Marshall Stevens's letter. As far back as 1883, in a letter published in the *Builder* supporting the Manchester Ship Canal project, one of the arguments I advanced was the almost certain appreciation of the land along the Ship Canal banks; that would, I contended, provide ideal sites for the establishment of manufactories and other new works; this appreciative value would alone, I then suggested, justify the very considerable proportion of the capital expenditure.

If we cannot compel our railway companies to adopt the American low freight rate policy, the only alternative, if a permanent profitable export trade is to be secured, is to establish our manufactories in such a position as to secure a sea frontage—or its equivalent, a maritime highway.

With the present policy of our railways, it would be positively advantageous to instal the works on the Channel sea-board of Northern France, because Newcastle coal can be obtained, as the Chancellor of the Exchequer recently pointed out, in the northern parts of France at a lower rate than it can be obtained in England at some miles from the British port of shipment. Besides, the manufacturer

established in France would have the advantage of the protection policy for France and her colonies, and, in addition, the same fiscal advantages in England and her colonies as are procured by the firm whose manufactory is installed here.

Whenever a line of frontage to a navigable estuary in proximity to a coalfield can be obtained, this position, all other conditions being equal, is the best for export trade.

The Board of Trade or the British Chamber of Commerce might appoint a committee to report on the comparative advantages of different sea-ports and their estuaries for the establishment of factories relying on export trade. If the Board of Trade was controlled by the President of the Chamber of Commerce, what a useful institution it might become! Of course, for internal trade proximity to the great railway centres—such as Carlisle, Crewe, York, Chester or Gloucester—might satisfy the requirements of an ideal site for the establishment of an electrical plant manufactory to satisfy internal requirements.

B. H. Thwaite.

Westminster, *May 21st*, 1901.

The Brighton Cable Contract.

Some weeks ago you published a series of letters which had passed between the Brighton Corporation and the Cable-Makers' Association, *re* the contract for the supply of cables to the former, which my company was fortunate enough to secure. I have waited to see whether any further letters would be published, but the correspondence appears to have stopped very abruptly.

The Cable-Makers' Association stated, and seemed to prove to their own satisfaction, that the prices of the Union Cable Company, Limited, were higher in the aggregate than those quoted by some members of the Association. It is impossible for anyone to say whether this is so or not without having the actual tenders for reference. I have a copy of the Union Cable Company's tender—which was in strict accordance with the Brighton specification, and, assuming that the members of the Cable-Makers' Association based their tenders on the "standard" tables set out in the printed circular issued by the Association in October last, their statement with regard to price would appear to require some further proof.

In making their comparison of prices, the Cable-Makers' Association altogether ignore the question of conductor resistance, but, if they quoted in accordance with these "standard" tables, the resistance is a considerable factor in the calculation. The greater portion of the contract price is for 1 square inch conductor cable, of which 7 miles are required. For this conductor, and for all others in proportion, the Union Cable Company, Limited, guaranteed a resistance of ·0422 ohm per mile at a temperature of 60° F., whilst the Cable-Makers' Association guarantee only ·044176 ohm at — — temperature. The "standard" tables omit all mention of the temperature at which resistance is to be measured, but if we assume that it is to be at the usual 60° F., then it seems to me that, all other conditions being equal, the value of the cables to the engineer is in inverse proportion to these resistance figures.

The Union Cable Company's resistance is 4·68 per cent. better than the Cable-Makers' Association's, and as the Cable-Makers' Association's lowest tender (£13,365) is only 4·2 per cent. lower than the Union Cable Company's (£13,952), it would appear, taking the 1 square inch conductor cable as a standard, that the Union Cable Company's tender really was lower than the lowest Association tender by ·48 per cent. on the value of cables alone. If we add to the Association tender (*a*) cost of return of empty drums, and (*b*) the one-third cost of drums which the Cable-Makers' Association insist on being paid in the event of drums being retained for a longer period than three months, even leaving out of consideration the fact that the buyers' engineer is buying exactly what he wants to buy, and not just what the seller wants to sell to him, I do not think there can be much doubt as to which is the more favourable tender for the buyer.

I trust that in fairness to my company you will be good enough to find space in your next issue for the above.

J. A. Blackwood,
Secretary to the Union Cable Company.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending May 22nd, 1900.	
Adelaide. Teleph. mat.	Value £96
Alexandria	73
Amsterdam	250
Boca. Teleg. mat.	76
Bombay	223
Boulogne	36
Buenos Ayres	727
" Teleg. mat.	200
" Teleph. mat.	72
Calcutta	730
" Teleg. wire	355
Cape Town	171
Chinde. Teleg. mat.	864
Colombo	135
Copenhagen. Teleg. wire	98
Durban	211
East London	9
Flushing	9
Hamburg	300
" Teleg. mat.	700
Melbourne	137
Riga. Teleg. mat.	64
Rio Janeiro	1,487
Rotterdam	45
Rouen	50
Santos. Teleg. mat.	199
Singapore	42
" Teleg mat.	65
Sydney	1,500
" Teleg. mat.	89
Vigo. Teleg. apparatus	179
Zanzibar. Teleph. apparatus	71
Total	£8,993

Week ending May 21st, 1901.	
Alexandria	Value £109
Amsterdam	220
Bombay	131
" Elec. motors	428
Buenos Ayres. Teleg. mat.	58
" Teleph. cable	1,040
Calcutta	1,893
Cape Town	709
Chinde	52
Durban	1,487
" Teleg. mat.	662
" Teleg. wire	295
East London	55
Gibraltar	10
Hamburg	16
Hong Kong. Teleg. mat.	120
Madras	1,018
" Teleg. wire	14
Mauritius	60
Melbourne	3,278
" Teleg. mat.	704
Ostend	126
Perth	220
Port Elizabeth	101
Rangoon	269
Rotterdam. Teleg. mat.	175
St. Petersburg. Teleg. mat.	618
Shanghai	401
Singapore	46
Stockholm. Teleg. mat.	110
Sydney	618
" Teleg. wire	42
Teneriffe	48
Trinidad. Teleg. mat.	25
Wellington	25
Total	£15,211

Foreign Goods Transhipped.

Trinidad.	Elec. lgtg. apps.	Value £44

Barbadoes.	Teleph. apprts.	Value £36
Rotterdam.	Elec. "	25
Trinidad.	Teleph. "	64
	Total	£125

Electrical Wares Exported.

Week Ending May 29th, 1900.	
Amsterdam	Value £305
Azores	36
" Teleg. apparatus	472
" Teleg. cable	329,000
" Teleg. wire	1,153
Bangkok	85
Barcelona. Teleg. mat.	340
Bilbao. Teleg. cable	1,330
Bombay	40
Buenos Ayres	200
" Teleg. wire	339
Calcutta	204
Cape Town	153
" Teleg. mat.	4,103
Christchurch	11
Copenhagen. Teleg. wire	279
Durban	34
East London	94
Gibraltar	110
Gothenburg. Teleg. cable	23
Halifax. Teleg. paper	51
Hamburg. Teleg. mat.	35
Hong Kong	641
Lyttleton	145
Melbourne	443
Montreal	80
Nagasaki. Teleg. cable	4,700
Port Elizabeth	100
Rio Janeiro	54
St. Petersburg. Teleg. cable	157
" Telephone	41
Shanghai	139
" Old teleg. wire	118
Singapore	82
Stockholm. Teleg. wire	428
Sydney	499
Wellington	68
Yokoska	3,078
Total	£349,170

Week ending May 28th, 1901.	
Adelaide	Value £45
Amsterdam	90
Bangkok	351
Buenos Ayres	499
" Teleg. mat.	497
Calcutta	1,775
" Teleg. wire	161
Cape Town	242
" Teleg. cable	9,600
Colombo	58
Copenhagen. Teleg. wire	92
Durban	536
East London	228
" Teleg. mat.	228
Gibraltar	13
Gothenburg	3
Halifax. Teleg. mat., 92 cwt.	—
Hamburg. Teleg. mat.	300
Hong Kong	17
Kobe. Teleg. mat.	6,534
Launceston	50
Limon	17
Lisbon	50
Madras	38
Mauritius	13
Melbourne	179
" Teleg cable	2,158
Ostend	80
Perth	120
Port Elizabeth	74
Rotterdam. Teleg. mat.	100
St. Petersburg. Teleg. mat.	300
Singapore	31
Sydney	1,141
Wellington	112
Yokohama	1,228
Total	£26,960

Foreign Goods Transhipped.

Tientsin.	Teleg. mat.	Value £269

Buenos Ayres.	Electric lighting apparatus	Value £180
Hamburg.	Elec. goods	100
Madras.	Elec. mat.	60
New York.	Elec. motors & parts	151
Perth.	Elec. goods	360
Total		£851

Bankruptcy Proceedings.—A general meeting of the creditors of Johnstone, Benjamin & Co, Crown Electric Works, 10, Ascham Street, Kentish Town, electric wire manufacturers, was held on Thursday last week at the London Bankruptcy Court, before Mr.

Egerton S. Grey, Assistant-Receiver, to consider a scheme of composition arrangement that has recently been submitted by the debtors. They propose to pay to their joint and separate creditors a composition of 10s. in the £ by means of two instalments, *i.e.*, 7s. 6d. on approval of the scheme by the Court, and 2s. 6d. at six months therefrom. The payment of the composition, preferential debts, fees, costs, &c., is to be secured by deposit with the trustees of the bankruptcy, who are also to be trustees under this scheme, of a considerable amount in cash, together with debentures in Johnstone, Benjamin & Co., Limited, and certain joint and several guarantees to be given by friends of the debtors. The scheme further provides that, upon its approval, the bankruptcy proceedings shall be annulled. The Official Receiver reported that the joint liabilities of the firm would amount to £8,045 10s. 10d., and the joint assets were estimated to produce £5,912. The separate liabilities of Lewis Benjamin amounted to £661, against assets of trifling value; whilst his partner, Ernest Emmanuel Benjamin, owed £9 9s., and had no separate assets. On the question of the benefit to be derived by the creditors under the proposed scheme, the Official Receiver reports as follows, viz.:—

"It will be remembered that in the Official Receiver's observations on the statements of affairs it was stated that on December 20th last the bankrupts transferred the lease and goodwill of their business and their plant, utensils, stock-in-trade, cash at bank, and good book debts (all valued, as a going concern, at £9,200) to a limited company in consideration of their appointment as managing directors of the company, at a salary of £250 per annum each for a term of seven years, and the payment to them of £9,200, payable as to £500 in cash, as to £1,500 in £1 ordinary shares, as to £5,000 in deferred ordinary shares, and as to £2,200 in 4½ per cent. debentures of the company, and that the cash consideration of £500 and 500 of the ordinary shares were paid to the person (a brother of one of the bankrupts) employed to form the company, whilst 250 of the ordinary shares and all the debentures, excepting two for £100 each, were handed to the trustees of the bankrupts' respective marriage settlements on account of debts alleged by the bankrupts to have been due from them respectively to such trustees under covenants contained in the respective settlements. The trustees of the bankrupts' estate have moved the Court for an order that the transfer of the business and assets to the company be set aside on the ground (amongst others) that it was a device to defeat and defraud creditors, and the hearing of the motion has been adjourned to enable the bankrupts to submit the above proposal to their creditors. The trustees report that at the request of the committee of inspection a meeting of the creditors whose debts exceed £150 has been held to consider the proposal, and that a resolution has been passed approving its terms. The sum required to pay the composition on the joint liabilities, preferential claims, and the costs and expenses of and incidental to the proceedings, including the trustees' remuneration and the costs of the motion, will amount to about £4,720. If the trustees' motion were unsuccessful there would, in the view of the Official Receiver, be no likelihood of a substantial dividend being paid to the creditors, whereas if it were successful it appears doubtful whether the assets recovered would yield more than the amount which is to be provided under this composite arrangement. The proposal therefore appears to be calculated to benefit the general body of creditors."

The proposal was formally voted upon, and was carried almost unanimously, the only creditors taken as voting against being those whose proofs had been admitted by the trustees, but who had failed to either attend or send in their voting letters. The chairman consequently declared that the scheme had been entertained by the statutory majority of the firm's or joint creditors, and in due course an application would be made for the approval of the Court to the arrangement.

In the case of the separate estates, the chairman adjourned the meeting for a week, there being some informality in the proof and voting letter of one of Mr. Lewis Benjamin's separate creditors. It was understood, however, that the scheme was accepted by all the creditors of the separate estates, and that the informality would be rectified in order that the proposal might be carried into effect in due course.

Dissolutions, Liquidations, &c.—The Electrical Inventions and Manufacturing Company, of Manchester, is winding-up voluntarily, with Mr. C. W. Provis, 3, Mount Street, Manchester, as liquidator.

Messrs. R. & H. Lomax (R. Lomax & Co.), electrical engineers, Darwen, have dissolved partnership.

Creditors of Sax, Slatter & Co. should send particulars of debts, &c., to the liquidator, Mr. A. A. Yeatman, by June 29th.

Books Received.—"Journal of the Institution of Electrical Engineers." Edited by W. G. McMillan, Sec. London: E. & F. N. Spon, Limited. 5s.

"Science Abstracts for May, No. 41." London: E. & F. N. Spon, Limited. 2s.

"Railway, Light Railway, and Tramway Progress." Being a special number of the *Engineering Times*. Westminster: P. S. King & Son. 2s. 6d.

"Telephone Lines and their Properties," by W. J. Hopkins. New York and London: Longmans, Green & Co. $6.

"Report of the Council of the City and Guilds of London Institute to the Members." April, 1901. London: Gresham College.

Catalogues and Lists.—The Britannia Company are circulating a list of their brass finisher's lathes.

Electromotors, Limited, of Openshaw, are sending out a priced card of their C.C. motors for standard and slow speeds.

Messrs. Buncher & Haseler, general stampers, &c., of Birmingham, show particulars of metals in which they stamp in a list just sent out.

The action of their friction clutch and details of prices, are given in a sheet issued by Messrs. Mackies, of Reading.

Messrs. Davies, Kent & Stewart, of Berners Street, W., send us a copy of their revised catalogue of electric light supplies, electric fans, electric bell equipments, &c.

Messrs. Dorman & Smith, of Salford, have issued a new illustrated list of electrical apparatus. Some views are given of central station lighting and traction switchboards which have been made and fitted up by them, also several types of main and other switches, cut-outs, safety fuses, ceiling roses, mill, ship, and other electric lighting fittings, "Damper" distributing fuse boxes, and so on. Prices and brief descriptive notes are given.

The General Electric Company send us a list of "Geeko" telephones which they are circulating amongst retailers. These lists include some of the instruments shown in the firm's large telephone catalogue, but have been edited with a view to appeal to the uninitiated. A "Geeko" telephone showcard has also been published.

Messrs. R. W. Blackwell & Co., Limited, send us a list giving particulars and prices of "I.T.E." circuit breakers, specially designed for protecting circuits against a reverse current. This class of "I.T.E." circuit breaker has received very severe tests, and we understand has proved itself to be thoroughly efficient.

The B.T.H. Co.'s list No. 95 describes their alternating current fan motors.

A large number of new lists have just been issued by Messrs. Johnson & Phillips. One gives a good deal of data in tabulated form regarding their wires and cables for a variety of electrical purposes. Another gives full details of the "Ark" lamps, together with prices of and accessories for same; this list contains some effective illustrations of the lamps, printed in art colours. Other sheets show interiors of central stations in this and other countries where J. & P. plant is to be found at work. Yet other lists are devoted respectively to the Hartmann & Braun ammeters and voltmeters; slow-speed central station dynamos; two-phase motor-generators and alternators; transformers; D.C. dynamos and motors; direct-coupled J. & P. dynamos and engines of different types; submarine cables and cable making and covering machinery.

The G.E. Company, Limited, has issued a priced list of "Paprifwire" bell wire.

Mr. C. D. Phillips, of Newport, is sending out circulars of Perkins's patent draw stroke trimmer and mitring machines.

The Electrical Company, Limited, has brought our a very neat card of E.C. ventilators for continuous, single-phase and three-phase current.

A copy of the fourth edition of Messrs. Mather & Platt's pocket catalogue is before us. It is about the neatest and most compact catalogue of electrical machinery that we have ever come across.

Claim for Compensation.—At the Poole County Court on Monday, before Judge Philbrich, Caleb Fudge, a platelayer, sued the British Electric Traction Company, Limited, under the Employers' Liability Act. The plaintiff was engaged from April to October last in the construction of a light railway at Upper Parkestone, and sustained a severe rupture while removing some rails. The award made was that the company should pay the plaintiff at the rate of 13s. 8d. per week, which was a moiety of his average weekly earnings, while incapacitated. The company had allowed him that sum up to April last.

Electric Fans.—The whole of the special ventilation of H.M.S. *Ophir* in connection with the equipment of this vessel for the Royal Colonial Tour, was carried out by Veritys, Limited, with their special electric motor and fan ventilating sets, in a period of 21 days.

Electric Pumping.—We are informed that Messrs. Ernest Scott & Mountain, who have for many years made a speciality of large electric pumping machinery, have recently completed many large installations. An important one was for a Scotch company, and the figures respecting the comparative working costs between the old system of steam pumping and electrical working are interesting reading:—The original pumps, which delivered against a total head of 581 ft., divided into three lifts of 160 ft. for the first pump, which was of Duplex type, 311 ft. for the second pump, which was also of the Duplex type, and 110 ft. for the third pump, which consisted of two 14-in. diameter buckets, required for attendance and working *seven men*, and the *coal consumption* 14 tons per day of 24 hours, the whole plant running seven days per week, and the *annual total cost* of pumping, without allowing for maintenance, breakdowns, cartage of coal, &c., was approximately £4,000. The new plant which the firm have installed consists of a horizontal compound condensing engine with a steam pressure of 80 lbs. per square in., driving on to a Scott & Mountain generator of 130 KW. capacity. The pumps, which are of the firm's special three-throw mining type with rams 11 in. diameter by 18 in. stroke, and deliver 500 gallons per minute against a head of 600 ft., are driven by a 140 H.P. electric motor. From very careful tests which have been taken, utilising the ordinary small coal, it has been ascertained that three men are now capable of attending to the whole plant, which is only run for eight hours per day out of the 24, the coal consumption has been reduced to 2½ tons per day, and the total working cost amounts to approximately £565 per year, showing a saving of £3,436 in working cost per annum. Apart from the question of interest and depreciation, which of course would apply in both cases, but would be greater in the case of the old steam plant than with the electric plant, we are informed that this result,

although exceedingly good, did not exceed the firm's expectations, as results practically as good have been attained in many other instances where they have installed their electrical pumping machinery.

Electric Traction Progress.—The *Engineering Times*, May issue, is a special number, being devoted entirely to railway, light railway and tramway progress. In general appearance it is very attractive; art printing, good illustrations and enamelled paper combining to produce a good result. The contents are naturally of considerable interest from an electrical standpoint, for everyone knows what a large part electricity is playing in railway and tramway development to-day. In his introductory comments, the editor, Mr. Ben Morgan, reviews briefly the whole field of transportation and emphasises certain points of present interest. He is followed by Sir Douglas Fox, who writes upon rapid transit in London in relation to the housing problem, and makes various suggestions for relieving the congestion of our streets to-day, underground railways and full extension of electric tramways being advocated. Sir William Preece deals with the subject of progress in electric traction, and among other things, says that want of financial support has held England back more than anything else. "Polyphase electrical traction," with reference to what has been done in Switzerland, forms the subject of a contribution by Prof. Carus-Wilson. Liquid fuel for locomotives on the G.E.R. is discussed by Mr. James Holden; other articles discuss English, American and French locomotive practice, Mr. J. G. White dwells upon the desirability of tramway securities as investments, Mr. J. W. White on the general question of light railways, and various other contributions go to make up a very full number.

Robertson Lamps.—At the exhibition which the Corporation of Ilford has organised in connection with the opening of the electricity works, and which opened last Monday for a week, there is an interesting demonstration of the manufacture of Robertson lamps by a glass-blower specially lent by the General Electric Company, Limited. The various processes of manufacture are shown in a popular manner. The G.E. Co. have received an order from Messrs. Waring & Son, of Hammersmith, for special Robertson lamps for the King's dining saloon on the new yacht.

Trade Announcements.—Mr. R. W. Blackwell asks us to announce that he has been compelled to make certain alterations in connection with his Paris office, which will in future be conducted under his personal direction. The resignation of the former director has been accepted. Certain statements to the effect that Mr. Blackwell's Paris office was about to be closed up are entirely without foundation.

The partnership of Messrs. Blakemore, Chantrey & Co. having been dissolved by mutual consent, Messrs. G. H. & W. H. Chantrey are retaining the offices at 57, Moorgate Street, E C., and will continue to practice at that address as formerly under the title of Chantrey, Chantrey & Co.

Messrs. Drake & Gorham's Manchester offices are from to-morrow (June 1st) removed from 100, King Street, Manchester, to 47, Spring Gardens, Manchester.

Messrs. Easton & Co., Limited, have appointed Messrs. Doddrell Brothers, of 11, Bothwell Street, Glasgow, as their sole agents for Scotland.

Messrs. Sulman & Picard, metallurgical chemists and assayers, have removed their office and laboratory from 60, Gracechurch Street, to 44, London Wall, E.C., where they will have increased space and facilities for carrying on their business.

ELECTRIC LIGHT AND POWER NOTES.

Ambleside.—Notice of the intended transfer of electric lighting order from the U.D.C. to the Windermere and District Electricity Supply Company, appears in the *London Gazette* for May 28th.

Birmingham.—The Electric Supply Committee states that the units sold, as compared with the previous year, were as follows:—

	Year ended March 31st, 1901.	Year ended March 31st, 1900.
Units sold	3,040,822 ..	2,357,506
Money value	£55,810 4 2 ..	£45,247 7 6

Showing an increase of 28·9 per cent. in units sold, and 23·3 per cent. in money value. The revenue account shows a gross surplus for the year of £15,352 18s. 7d., but had only the usual charges in connection with the generation of electricity and maintenance been debited against it there would have remained a balance of £27,233 10s. 4d. wherewith to meet the interest and sinking fund charges, which amount to £21,838 17s. 9d. The exceptional charge against revenue is the cost of altering and improving a portion of the feeder mains and of changing over sections of the system from 110 to 220 volts. The works are in excellent order, and operations have been carried on throughout the year without stoppage or serious accident of any kind. The lamp and motor additions during the year reduced to a 6-C.P. factor, amount to 11,855, bringing the total number of lamps to the end of the financial year to 8,293, an increase of 17·8 per cent. The total number of motors now connected amounts to 260. The relaying of the older mains in the centre of the city has been completed, and the uniformity of the system has thus been effected. The committee mention that any large extension of the area of supply will necessitate the establishment of new power stations.

Canterbury.—Last week Mr. F. H. Tulloch, M.Inst.C.E., one of the L.G.B. inspectors, held an inquiry into the application of the T.C. for sanction to borrow £17,000 for purposes of electric lighting.

Cleckheaton.—Tenders have been accepted by the U.D.C. for the erection of an electric generating station and a refuse destructor combined.

Cork.—As a result of the prolonged strike of gas stokers, the Harbour Board has decided to adopt electricity in place of gas for swinging the bridge across the River Lee.

Croydon.—On the recommendation of the Lighting and Electricity Committee, the Croydon County Council has resolved to extend the mains at a cost not exceeding £1,200.

Edinburgh.—During the 12 months just ended, the applications for electrical energy reached the unprecedented total of 194,000 8-C.P. lamps.

Erith.—The D.C. has approved of the plans and specifications of Mr. Hawtayne for the electric light installation, and tenders will be invited shortly.

France.—An important central power station has just been completed at Saut-du-Mortier, France, for the distribution of electrical energy. The motive power is supplied by the Ain river, which at the point of derivation partakes of the nature of a torrent. With a minimum supply of 4 cubic metres per second the available power would not exceed 600 H.P. In order to secure a regular power of 3,000 H.P., a canal has been constructed to flood the river in time of drought by the waters of the Chalain Lake, situated about 30 miles distant on the left bank of the Ain, from which it is only separated by a deposit of earth. A subterranean canal leading from the bottom of the same lake can take 12 cubic metres per second, thus giving a total catchment of 16 cubic metres. The normal level of the lake being 32 metres above that of the river at the nearest point and its area being about 500 acres, it will be seen that there is always an important reserve of water, and in reducing the level of water to 10 metres, there is still a content of 20,000,000 cubic metres. The works executed on the Ain comprise a barrage 10 metres high and 45 wide, and a canal 1,500 metres long, 125 metres of which is underground. The power station covers an area of 650 square metres, and at present contains four units, each consisting of a Piccard & Picet turbine of 700 H.P., coupled to a three-phase Oerlikon alternator at 7,500 volts. Another unit will be installed at an early date. This station furnishes light and power to the towns of St. Claude, Orgelet, Arinthod, Oyonnax, and several others within a radius of 13 miles.

Germany.—The municipal authorities of Frankfort-am-Main have just voted a sum of £42,500 for the extension of the central electric lighting station in the town.

Greece.—La Société Hellenique d'Electricité (Système Thomson-Houston) has recently secured concessions for the electric lighting of the towns of Sira, Calamata and Patras.

Halifax.—The report by the B. of T. experts with regard to the explosion at the Halifax Electricity Works on December 10th last, whereby a labourer lost his life, has been published. The explosion occurred through the bursting of a steam pipe which was "a little spongy" in two places, forming together about one-fifth of its circumference. Says the report:—"The cause of the explosion is not very clear, but it was, I think, more probably a combination of two or more actions rather than any single one. In the first place the material was not sound, and owing to the form of joint used, severe stresses of unknown magnitude would be caused when the joint was screwed up. The pipes in the boiler house are supported by hangers, and no provision is made to take up the expansion, nor are means fitted to drain them except in the engine room, although the range is said to be horizontal. Having regard to the pressure used, it would also, in my opinion, have been advisable for ribs to be provided at the flanges of these cast-iron pipes, or still better, that some other material should have been used. These works belong to the Halifax Corporation, and although on two previous occasions fractures of the pipes have occurred, yet it does not appear that any steps of practical use had been taken to prevent similar occurrences. In the present instance a labourer has unfortunately lost his life, and perhaps some action will now be taken. In any case it is, I think, far from creditable to the officials of a wealthy town such as Halifax that an occurrence of this nature should arise from property under their charge, more especially after they had been warned by the previous failures of the same range of piping."

Hampton.—The B. of T. has granted a prov. order to the D.C. for the supply of electricity in the district.

Ilford.—Street electric lighting was formally inaugurated on Saturday last at Ilford, which is spending £70,000 on an electrical undertaking.

Italy.—Mr. P. Frova, proprietor of a cotton mill at Cannobio, has applied to the Italian Minister of Public Works for the concession of a derivation of water from the Cannobio and Cavaglio torrents on the territory of the Communes of Cannobio, Cavaglio, St. Donnino and Trefiume. The object of these catchments is the development of electric energy for the supply of motive power to various industries in the neighbourhood, and for electric lighting and traction purposes.

The Societa di Montecani, on the favourable recommendation of the Communal Council of Massa Maritima, are about to receive a

concession of an important waterfall situated in the Commune. The company will *per contra* furnish water, electric light and motive power to the Communal authorities.

Kendal.—The T.C. has received the sanction of the L.G.B. to borrow £14,000 for the electric lighting installation.

Leeds.—The accounts of the electric lighting undertaking show that the receipts for the year amount to £43,669 2s. 2d., and the expenditure (including the payment of interest) to £29,154 16s. 4d., leaving a surplus of £14,514 5s. 10d. From this sum £7,632 15s 2d. has been deducted in respect of sinking fund, so that the net surplus is £6,881 10s. 8d. Last year's surplus was £8,500; the difference of £1,621 is due to the high price of coal. There are about 2,000 consumers.

London.—L.C.C.—The Council has resolved that a letter should be addressed to the B. of T. suggesting that legislation be promoted by the Government to provide that the list of share and debenture holders in companies supplying gas, electricity, water or hydraulic power, or owning docks or wharves, or undertaking tramway, telephone, or other public services within the county of London, shall be open to inspection.

STOKE NEWINGTON.—The Borough Council has applied to the Hackney Borough Council, asking that the latter shall supply electricity to the Stoke Newington High Street until such time as it possesses its own municipal supply.

Newport.—At a lively meeting of ratepayers last week a resolution was carried by a large majority, calling upon the Corporation to rescind a resolution passed by it at the last meeting, when tenders for the new power station were accepted to the amount of £50,000.

Nôtre Dame (Paris).—The old cathedral of Nôtre Dame is to be lighted by electricity. In spite of its enormous size, Nôtre Dame has hitherto been lighted by wax candles, as gas, it was thought, would damage the walls and valuable paintings. The cost of installing the electric light is estimated at £18,000.

Pemberton.—Steps are being taken to obtain another £10,000 for electric lighting.

Perth.—The electricity works of the city are to be formally opened to-morrow. After the ceremony there is to be a banquet at which Convener Wright is to be made the recipient of a presentation. Messrs. Hawtayne & Fairley have carried out the work.

Rotherham.—On Thursday last week the Corporation electric light and power station was formally opened by Mr. Winter, chairman of the Electric Light Committee, in the presence of a large company. The installation was designed in accordance with the specifications of Messrs. Kennedy & Jenkin, and consists of two Lancashire boilers, an economiser by Messrs. Green & Co., piping and generating plant by Messrs. Allen & Co., Bedford. There are two 150-I.H.P. steam dynamos, and two smaller engines with a dynamo at each end running at 500 revolutions per minute. The battery, made by the E.P.S. Company, is capable of discharging at the rate of 50 amperes for five hours at a pressure of 460 volts. Messrs. Kelvin and White, of Glasgow, supplied the switchboard and booster. Messrs. Callender put down the cables. All of the electrical engineering work was done under the direction of Mr. A. F. Davis. The whole undertaking is estimated to cost about £24,500, and the department will be able to supply current to between 4,000 and 5,000 lamps at one time. Mains have been laid for 10,000 lamps.

Russia.—La Société d'Eclairage Electrique de St. Petersburg is now supplying current from its various stations to an equivalent of 183,790 10-C.P. incandescent lamps, this being an increase of 68,795 lamps on the year.

Spain.—The British Vice-Consul at Ferrol reports to the B. of T. that a new electric light company has been established in that town with a capital of 2,000,000 pesetas (about £65,000) for the purpose of supplying light and energy not only to Ferrol but also to all the small towns and villages round the bay. The waterfall, which is about 160 ft. high, and capable of producing up to 2,000 H.P., is situated at La Fervenza, a lovely spot about 12 miles from Ferrol. The company, the shareholders of which are French and Spanish, is the same that has established the electric light at Caldas, Villagarcia, Carrill, &c. All the machinery and wire required will be imported from Germany and France.

Stafford.—The accounts of the electricity department show an increase in the year's receipts from sale of energy of 100 per cent. The expenditure, however, had been much higher than was expected.

Taunton.—A L.G.B. inquiry was recently held by Col. W. R. Slacke, R.E., into an application by the Taunton T.C. for permission to borrow £20,000 for electric lighting purposes. There was no opposition.

Teignmouth.—The D.C. has decided to abandon the idea of adopting electric light. The cost of obtaining the prov. order was £550.

Walker.—Sanction has been obtained by the U.D.C. to the borrowing of £18,559 for electric lighting, and £14,700 for a refuse destructor.

West Bromwich.—The public electricity supply was begun on Friday last. The works will be formally opened in a month.

Weston-super-Mare.—The electricity works, which are owned by a company, commenced operations last week with a connection of 4,000 to 5,000 lamps.

Wimbledon.—The official returns of the electric lighting department are as follows:—Receipts for year ending March 31st last, private consumers £5,479, street lighting £4,028, compared with £2,384 and £286 respectively for 1900. The working expenses were—1900, £2,322, and 1901, £6,338. The total debt is now £46,125.

Shanklin.—The D.C. has resolved that the streets be lighted by electricity, provided that satisfactory terms be arranged with the E.L. company.

ELECTRIC TRACTION NOTES.

Aberdeen.—The T.C. has agreed, on the recommendation of the Tramways Committee, to proceed with the reconstruction of a double line of the tramway in Great Western Road, between Forbesfield Road and Ashley Road, and also between Great Western Place and Holborn Street; that the line be electrically equipped, and that the work be carried out by the British Insulated Wire Company at the scheduled prices for the present contract.

Belgium.—As we forecasted last week, the Antwerp Tramways Unification Bill has been passed by the Belgian Senate. The following are the principal lines affected:—

	Old concession expires.
Tramway du Sud	1920
Tramway Nationaux	1911
Tramway Maritime	1916
Omnibus d'Anvers..	1916
Tramway-Omnibus	1941
Tramway Suburban	1933
Tramway Anversois	1929
Tramway rue d'Argile	1935

The new Bill provides for the amalgamation of all these lines under the jurisdiction of one company, and the conversion of the present animal traction into electrical traction with reduced fares. A concession will be ceded to the new company till 1945.

Birkdale (Southport).—The township has for some time possessed a provisional order from the B. of T. to establish electrical works, and the British Electric Traction Company has received permission from the Council to proceed with a scheme for laying electrical tramways. The provisional order is likely to come before Parliament for confirmation at any time, but strong opposition to the scheme is expected from the Lancashire and Yorkshire Railway Company, as the tramways will have to pass over the railway company's lines at two points unless bridges are erected, which would be a costly undertaking. Power has been granted to Warrington to run electric trams over a level crossing with four sets of rails. In the district public feeling is strongly in favour of running the tramcars over the level crossings at Birkdale, and is against the attitude which the railway company maintain in the matter.

Blackburn.—In his second annual report upon the working of the Blackburn Corporation tramway, Mr. A. S. Giles, the general manager, states that during the year the Corporation received a revenue of £36,972 6s. 9d. from the trams, and the working expenses were £28,947 16s. 1d., leaving a gross balance of £8,024 10s. 8d. The capital charges, however, amounted to £11,801 4s. 5d., thus leaving an adverse balance of £3,776 13s. 9d. The amount at present borrowed for capital is £215,478. The traffic has increased from 7,478,422 to 7,614,838 passengers in the past year, and the receipts from £35,808 14. 5d. to £36,972 6s. 9d., the average per car mile being 11·84d. and 11·98d. respectively. Mr. Giles explains that the upkeep of the steam cars and engines has been very heavy, and the electric car expenses are higher than they will be when all are working by electricity, on account of the expenses of handling the new cars as they are delivered, and this expense can only be placed against revenue. The receipts per mile on all sections have not realised expectations, partly owing to the considerable early morning mileage run by way of experiment. Mr. Giles suggests certain increases of fares, and states that he does not anticipate much decrease in the number of passengers if they are raised. He estimates that with the increased receipts the balance at the end of this year will be sufficient to pay all charges, and in the event of the tramways making extra profits in a year or two, the fares could then be lowered. This proposal will shortly come before a meeting of the Corporation.

Blackpool.—A double line of tramways round Marton (Blackpool) has been completed. The official inspection was made on Thursday last week by Major Druitt. There are 15 cars on the system which would accommodate 67 passengers each. The cars are supplied with the most modern appliances. The overhead wires are provided with Quin's patent cut-outs, and at points where telephone wires cross the electric line wires guard wires are provided. The tramways and equipment will have cost £100,000. The cyclists of the town are complaining about the ¾-in. groove in the new line owing to the liability of their tires to become fixed in it.

Brighton.—The chairman of the Tramways Committee and the tramways engineer have paid a visit to the works of Messrs. Milne & Co., Wellington, Shropshire, to inspect the first finished electric tramcar for the tramways which the Corporation are now constructing. They saw also the other cars, 25 in number, which are in an advanced state, so that it is anticipated that the whole will be delivered well within the contract time.

Clacton.—A proposal for the construction of electric tramways from Old Clacton to Clacton-on-Sea and along the front is under consideration.

Dublin.—Last week Mr. Trotter, Board of Trade inspector, made an inspection of the electrical equipments of several portions of the electric traction system of the Dublin United Tramways Company. The inspection was confined to the overhead wires in British Street and South Quays, which had not previously been inspected.

Electrical Omnibuses in Austria.—The Accumulatorenfabriks Gesellschaft, of Vienna, has secured a concession to work a service of electrical omnibuses between Payerbach and Hirschwang. The vehicles are being built by Messrs. J. Lohner and Co., of Vienna, and are on the Lohner-Porsche hub motor system, the necessary electrical energy being furnished by a battery of Tudor accumulators.

Glasgow.—Last week the permanent ways of certain of the electric tramway lines in Glasgow were officially inspected by Colonel Yorke for the Board of Trade.

Lancaster.—The Electric Tramways Committee have rejected an offer from a Birmingham syndicate to purchase all the rights to construct the network of tramways in the borough for which powers were granted in the Parliamentary Bill last year. The Corporation have really been endeavouring, along with the Morecambe Urban Council, to acquire the existing horse tramway from the borough of Lancaster to Morecambe. The syndicate first tried to acquire the Lancaster to Morecambe line, offering terms at par, whereas the Corporation, knowing the lease of the company expires in 10 years, only negotiated for 15s. per £1 share. This was declined, but some of those interested in the tramways company are members of the Corporation, and the re-opening of negotiations has been suggested. The offer of the syndicate was conditional that an extension of the lease was obtained from the Corporation, and as this is not likely to be granted, the scheme will probably fall through. Meanwhile Mr. W. A. Tester, the borough electrical engineer, is busy preparing for the installation of the electric tramways upon the principal routes. When it is completed the cost will be about £70,000.

Light Railways.—The Commissioners have submitted to the B. of T. for confirmation the Rhondda Valley Light Railway order. Tuesday's *Gazette* contains notices about the following:—The Turton, Tottington, Ramsbottom and Rawtenstall (Lancashire Light Railways Company); Spen Valley and Morley Extensions (British Electric Traction Company); Crewe Light Railways (B.E.T. Co.); South Shields, Sunderland and District Light Railways (B.E.T. Co.); Potteries Light Railways Extensions (Potteries Electric Traction Company); Middleton Light Railways (Deviation) (B.E.T. Co.); Southend (Burnham-on-Crouch to Bradwell-on-Sea) (Railways and General Construction and Maintenance Company); Woolwich, Eltham and District Light Railway (Auxiliary and Light Railways and Tramways Company); Preston and Lytham; Holmfield and Southowram; Southowram and Elland; Crowland and District (Crowland and District Light Railways Company). See also "Parliamentary Powers," p. 932.

Liverpool.—Another new tramway route was opened in connection with the electric tramway system on Sunday. The new route is from Smithdown Road, in the south-east of the city, to the Pier Head, through a central district.

London Tube Railways.—A correspondent sends us the following:—"The present steam railway system of the metropolis carries evidence in itself that it was not thought out as a whole, but that it has grown by piecemeal. Nothing could well be worse than the present railway system of London. Each bit of line appears to have no proper point of starting and no well-schemed route. All is a confused hotch-potch. Exactly the same confusion appears to be growing below ground in the case of the tube electric lines. When a few more have been constructed it will begin to be difficult to construct others as they ought to be constructed. We may suppose a line is to run east and west, and to cross some half-dozen north and south lines. What has been done to prepare for this eventuality? The hypothetical new line might find itself like a thread of waft in a bit of coarse canvas, alternately above and below succeeding threads of warp. This is a contingency very likely to occur, and it ought to be guarded against. In some parts of London especially the united thickness of the London and plastic clays is not great, and there ought to be no water of critical height at these points. The construction of a new tube railway seems all a matter of chance, depending upon the crude ideas of promoters, made irrespective of any such points as we have advanced. Now that tube railways bid fair to be so numerous in the near future, is it not high time that a general system should be worked out with all junctions and necessary loops and crossings? Such a system should be designed with a view to the most advantageous routes being selected, and it should be a very full scheme, including a close network of permissible lines. Having been thus decided upon, any set of promoters would be at liberty to select any section of the system, and to construct the same in the direction shown on the plan of the authorised general scheme and *at the authorised depth*. In this way it would not cost many pounds to acquire permission to construct a line. As piece by piece was constructed, the whole system would begin to assume form, and perhaps in time every piece might be laid down. As time passed it might appear that modifications in the scheme as regards unconstructed lengths could be advantageously made, as local conditions varied from anticipation, and all such desirable changes could be made on the plan of the "authorised lines" so as not to mar the general effect. Individual promotions must ultimately bar the way to future extensions, because no consideration is given to such extensions by the promoters of the lines so far built or proposed. The future of the whole tube system is being jeopardised by this unwarrantable selfishness. As an example of the influence of bad and uncontrolled plans, we may instance the line from Ludgate Hill below ground to Farringdon Road *vid* Snow Hill. When an electric line was proposed from St. James Street to the City, its promoters felt themselves compelled to stop at Holborn Circus, because they were unable to cross the Snow Hill line above, as this would have run them either above the Viaduct, or so as to interfere with the small streets which pass below the Viaduct. The only space available was that below the Snow Hill line, and the promoters did not care to make this deep descent, as it was felt necessary to have a shallow station at the Holborn Circus. The irresponsible boring of tube lines at the sweet will of the promoter will entail many similar difficulties in the future, especially when the undulating system of the Central London line is followed to any great extent."

Manchester.—The Moss Side District Council has received the agreement with the Manchester Corporation in regard to the construction of tramways in Moss Side. The matter is now completed. It was stated that no date had been fixed for the commencing of the laying of the lines in the district, but the Corporation had promised that the work should be begun as soon as possible.

Motor Car Trials.—There have been 13 entries of motor vehicles for the forthcoming trials of heavy motor vehicles, which are to take place from June 3rd to June 7th in the Liverpool district. The vehicles are all oil or steam propelled, no electrically propelled vehicle having entered up to the present time.

New York.—The cable on the Columbus Avenue line of the Metropolitan Street Railway Company was taken out on Saturday, 11th inst., and the electric conduit system inaugurated. People along the line gave the last cable car a lively farewell, fireworks being set off at some points, and there was much cheering. The Broadway line is now the only one in the city operated by cable, and this is practically ready to give way to electric power.—*Electrical World.*

Oldham.—Major Druitt, on behalf of the Board of Trade, made an official inspection of Lees Road and Glowick Road (new sections) of the Corporation electrical tramways. Everything passed off satisfactorily. The inspector said the cars are not to be run without slipper brakes, and the Tramways Committee are now consulting their engineer as to what kind to adopt. On Monday, at the Borough Police Court, the Corporation summoned about a dozen young lads for placing file-cutters' chisels in the grooves of the rails in Middleton Road. Fines were imposed by the magistrates in all the cases as a warning to others.

Paris Underground Railway.—The Paris correspondent of the *Financial Times* sends the following interesting notes about the Paris electric underground line, which has already been described in these columns. The first annual general meeting of the Paris Metropolitan Electric Railway Company was held a few days back, and it may be of some interest to shareholders in the Central London and other electric "Tubes" to know the results of the working of the new Paris Metropolitan Electric line. The system is ultimately to be greatly extended, and in a few years' time Paris will be endowed with a perfect network of underground electric railways, but at present the only line open and working is that running right across the city from the Porte Maillot to the Porte de Vincennes, with two short branches from the Place de L'Etoile (Arc de Triomphe) to the Trocadero and to the Porte Dauphine. The accounts presented at the meeting showed the working results from July 19th, the date of opening, to December 31st last. The total gross receipts for this period were £107,764, and the working expenses amounted to £41,741, so that the profits worked out at £66,023. The proportion of these profits paid over to the City of Paris, in accordance with the terms of the concession, was £36,252, so that the company's net profits worked out at £29,771. Advertisements and other side products increased the net profits to £58,702. After provision was made for legal reserve, a dividend of 7.50 francs per share was declared, which absorbed £30,000, and left £6,782 to be carried forward. The directors, in their report, also stated the working results for the first four months of 1901—January—April. These were as under:—

Traffic receipts during first four months, 1901	£107,529
Working expenses during same period	45,901
Gross profits	£61,719
Proportion to City of Paris	44,930
Net profits of company	£18,799

The proportion of working expenses to receipts, which was below 40 per cent. during the first few months of the opening of the line, rose to 42 per cent. in December, to 44 per cent. in January and

gradually fell to 40 per cent. in March and April. The report points out, however, that it is somewhat deceptive to calculate the proportion of working expenses at so much per cent. in a line such as is the Paris Metropolitan, because the existing organisation, with trains of four carriages and a maximum of circulation, necessitates continual expenses which do not admit of a fair comparison. The company hopes sooner or later to increase the length of its trains to seven or eight carriages, but before this can be done it is absolutely necessary to construct a number of sidings. It is hoped that the municipal council will give the necessary sanction in time for the sidings to be completed by March, 1902. The length of line open is 13 kilometres 300 metres, or over eight miles. The rolling stock consists of 41 first-class carriages, 74 second-class carriages, 34 one-box motor carriages, and 12 two-box motor carriages. The average receipt per passenger is exactly 0 francs 1·693 decimes and per train kilometre 3 francs 2·059 decimes. The city authorities are actively pushing on with the tunnelling and superstructure work of the second road, to be opened next year. This is a circular line on the north side of the river, *vid* the outer boulevards, between the Etoile and the Place des Nations. The total mileage to be ultimately worked by the Paris Metropolitan Electric Company is not yet fixed, but it is evident that the present capital of £2,000,000 will be insufficient to work the first 50 kilometres.

Parliamentary Powers. — Last Friday's *London Gazette* contained the petition of the City and North-East Suburban Electric Railway promoters for various additional powers, including the use of lands at Low Leyton for the construction of a generating station.

Applications regarding the Lizard Light Railway Order, the Woodbridge District and Bawdsey Light Railway proposed order, the Gower Light Railway (Light Railways Syndicate), and the Rother Valley Light Railway (Company), appear in the same issue.

Perth.—Mr. Lambert, the resident electrical engineer, has now completed his report on the proposal that the town should take over the tramways and adopt electricity as the motive power. The contents of the report have not yet been made public.

Plymouth.—The Plymouth, Stonehouse, and Devonport tramways system is about to undergo conversion. The gauge is to be reduced from 4 ft. 8½ in. to 3 ft. 6 in., which will make the line uniform with the other systems in Plymouth and Devonport. Electric traction is to be substituted for horse-power.

Poole and Bournemouth.—The directors of the Poole and District Electric Traction Company, Limited, gave an invitation dinner on Wednesday night at the Grand Hotel, Bournemouth, to celebrate the opening of the light railway between Poole and Bournemouth, also the inauguration of the work in connection with the Christchurch and Bournemouth line. Mr. E. Garcke, chairman of the company presided, and the company included the Mayors of Bournemouth and Christchurch, and the chairmen of the various local district councils and other bodies, Mr. W. M. Murphy, and Mr. P. G. Hamilton Carvill, M.P. The toasts were, "The Prosperity of the District," "The Guests," and "The Tramway Service." Reference was made to the fact that the Corporation tramway lines would, in conjunction with those of the company, connect the ancient towns of Christchurch and Poole, which were 10 miles apart, the system running through the centre of Bournemouth.

Portsdown and Horndean Light Railway.—At the last meeting of the Hampshire County Council it was reported that the promoters of the above had applied for permission to use steam locomotives upon the intended light railway, on the ground that electric equipment and traction was too expensive, excepting on a service for which a very frequent service could be profitably worked. Section 61 of the order, authorising the construction of the railway, provides that steam locomotives shall not be used except with the consent and according to a system approved by the Board of Trade, and with the consent of the road authority. A committee of the County Council reported that they had communicated with the three District Councils interested, and had ascertained that they strongly objected to the use of steam locomotives. Having regard to these views, and also to the fact that the order was obtained by the promoters on the understanding that electric traction would be used, the Committee had intimated to the promoters that they could not recommend the County Council to consent to the use of steam.

Singapore.—At a meeting of the Singapore Municipality, the president reported the receipt of an application asking if the Commissioners would consent to the construction of an electric tramway. The president said the adoption of the proposal meant an expenditure of $2,500,000, and if the wires were placed underground it would mean another million and a-half dollars, and this latter fact would perhaps put a stop to the scheme altogether. The Finance and General Purposes Committee had recommended that the Commissioners concur in the opinion as to the necessity for the underground system, and the president moved that this be adopted. The recommendation was then put and carried with one dissentient.

Southampton.—An intimation has been received from the Board of Trade that they are prepared to sanction the proposed loan of £80,000, repayable in the periods usually allowed, as follows:—Permanent way, £53,820—30 years; electrical equipment, £7,230—20 years; cars, £18,950—15 years. The Tramways Committee of the T.C., after considering quotations for indemnifying the corporate body against claims under the Workmen's Compensation and other Acts with respect to employés in the tramway department, have resolved to continue the insurance with the General Accident, &c., Company, Limited, at 40 per cent. on the wages paid, subject to the company agreeing to include risk by electric shock and under Lord Campbell's Act.

Sunbury and District.—The U.D.C. has received official notice that the Middlesex County Council propose applying for powers to construct two light railways affecting their district, one extending from Kingston Road, Staines (from the junction with the Staines and Egham line already authorised) and passing through Laleham, Ashford, Littleton and Hampton; and the other commencing at Twickenham, passing through Hampton and Hanworth to Sunbury Cross. The County Council also purpose to acquire land at Sunbury for a power station and car depôt. The gauge is to be 4 ft. 8½ in., and the traction "otherwise than by steam." These lines are part of a scheme for 73 miles of light railways proposed to be constructed in the parishes of Enfield, Edmonton, Southgate, Wood Green, Finchley, Hendon, Willesden, Wembley, Harrow, Stanmore, Edgeware, Acton, Old Brentford, Ealing, Norwood, Heston, Isleworth and Twickenham.

Sunderland.—On Wednesday, May 22nd, the first of the extensions of the Sunderland tramways was inspected by Lieut.-Col. Von Donop, of the Board of Trade. This is a short section, about three-quarters of a mile long, and forms a continuation of the Roker system, which is very largely patronised by visitors to that seaside resort. The line runs to the extreme boundary of the borough towards Whitburn, and it is expected to be utilised by the villagers. The section is a straight run, and was generally informally approved by the inspector, and cars were run along the lines the same day. The work has been carried out by Messrs. Dick, Kerr and Co., the original contractors.

The company who have in hand the scheme for the running of tramways in the district around Houghton-le-Spring (Durham County), have approached the Sunderland Corporation Tramways Committee with a view to obtaining running powers over their lines into the borough. A sub-committee has been appointed to deal with the matter, but has not seen its way to recommend that such powers be granted. The Committee is prepared to recommend that negotiations be entered into for arranging through rates both for passengers and parcels.

Surrey County Council.—The arrangements between the Parliamentary Committee of the S.C.C. and the London United Tramways, Limited, provide for a payment by the company of a yearly rental of £100 per mile, and for the Council to have the option of purchase in the event of local authorities not exercising their covenanted rights. The company also agreed to contribute substantially to the cost of widening Kingston and Hampton Court bridges in the event of tramways being laid across them, the amount in the case of Kingston Bridge being a maximum of £10,000.

Twickenham.—Subject to the approval of the Parliamentary agents, the U.D.C. has decided to withdraw its petition against the London United Tramways Bill, on the company undertaking to allow the Council the option of purchase independently of the action of neighbouring authorities, and on also promising not to construct any cable-way through the district unless also constructing a tramway line. There are a few other minor provisions. The company has paid the Council's legal costs in full.

West London.—On Bank Holiday an immense traffic was carried on the electric trams of the London United Tramways Company. A one-minute service was maintained from seven o'clock in the morning until an hour after midnight, during which period 209,636 passengers were conveyed over the nine miles of route now opened. For the corresponding day last year, when the horse cars were in operation, the total was 81,500, and for last Bank Holiday, when the electrical system was placed in operation for the first time, 164,000 passengers were carried.

Wimbledon.—Following on the abortive attempt of the U.D.C. to promote a tramway Bill, the Council has now applied for a provisional light railway order.

TELEGRAPH AND TELEPHONE NOTES.

The Borkum-Bacton Cable.—It is stated in the *Times* that the laying of the second half of the Borkum-Bacton cable by the steamer *Von Podbielski* has been successfully completed.

Indian Telegraphs.—According to a recently issued report, the State telegraph network in India now extends to a length of 52,909 miles. Altogether there are 170,766 miles of telegraph wires and 283 miles of cables in use.

Italian Telegraphs.—The Italian Government has voted a subsidy of 150,000 lires for the construction of a new telegraph line between Genoa and Milan, and with a view to relieving the present lines of communication to Paris and London.

Telegraphic Interruptions and Repairs :—

	Cables.	Interrupted.	Repaired.
Latakia-Cyprus	.. ..	June 20, 1899 ..	..
Para-Maranham	.. ..	March 1, 1900 ..	..
Landlines :—			
Bolama-Bissao	.. ..	May 19, 1901 ..	..
Cayenne-Pinheiro	.. ..	April 20, 1901 ..	..

(Continued on page 937.)

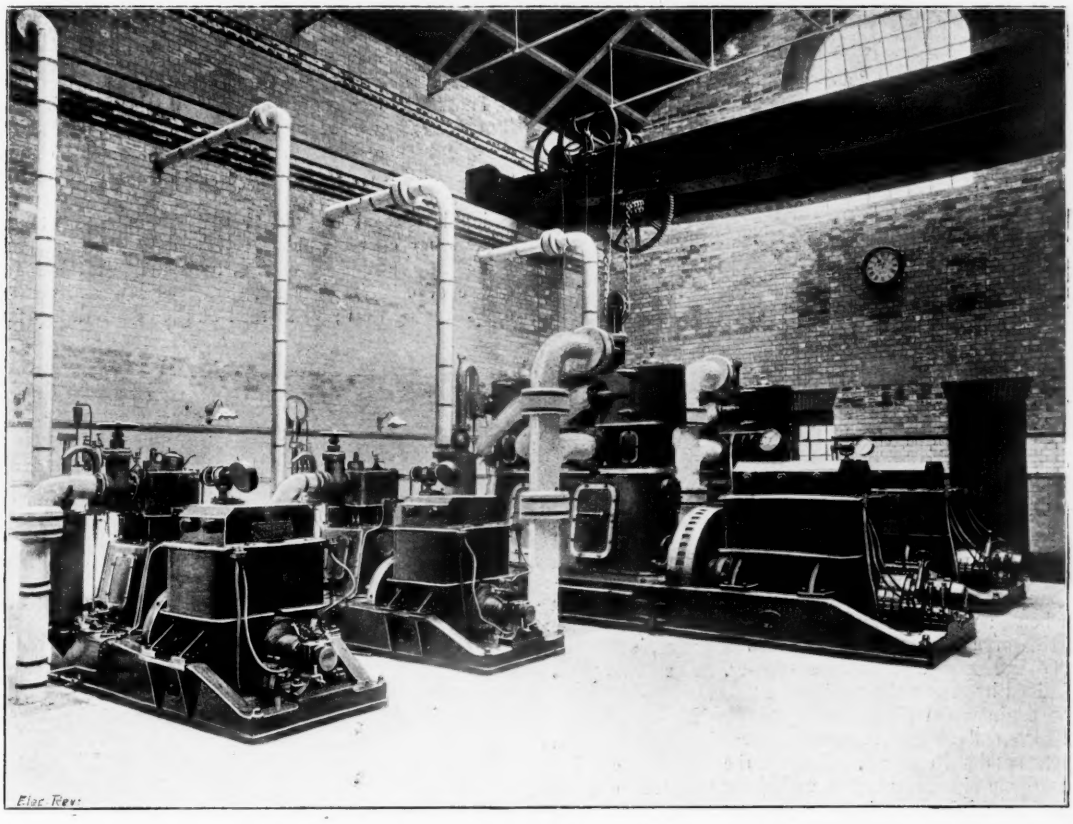
BARNES ELECTRICITY WORKS.

One of the latest municipalities of Greater London to embark on the commercial supply of electrical energy is the Barnes Urban District Council. The area controlled by this authority, bounded by Richmond, Putney and the Thames, is very extensive, and includes several buildings of more than local fame, such as White Lodge, Sheen House, the Ranelagh Club-house, &c. Moreover, while the present population amounts to about 18,000, so rapidly is London overflowing into the surrounding districts that already building plans have been drawn up to accommodate no less than 40,000 inhabitants in the near future. In addition to the large residential element, there are several large industrial concerns within the Council's boundaries, and the probability of a demand for charging the accumulators of motor-cars and launches is, in view of the situation of the works, by no means poor. It will be seen, therefore, that the undertaking commences operations under most favourable auspices, and with every likelihood of developing into a very profitable and important system.

The Council obtained a provisional order in 1898, and appointed as consulting engineer Mr. W. Fairley, engineer to the Richmond Main Sewerage Board. A Local Government Board inquiry was held, and sanction granted to a loan of £30,963 in July, 1899. The method of supply adopted was the direct current three-wire system, with a declared pressure of 210 volts. The site of the generating station is on the right bank of the Thames, close to the tow-path, affording facilities for the supply of coal and water. At present coal is delivered in barges, and is brought into the station by carts; but it is intended to instal mechanical coal-handling apparatus to avoid the expense and inconvenience of this process.

The buildings include engine room and boiler house, engineer's offices, test room, stores, workshop, men's mess room, battery room, &c. The boiler and engine rooms are closed by a temporary end of galvanised iron and match-boarding, to provide for extensions; they are well lighted and ventilated from the roof.

The steam-raising plant consists of three Babcock and Wilcox boilers, of 250 H.P. each, constructed for hand stoking and fitted with superheaters. Each boiler is capable of evaporating 5,000 lbs. of water per hour, at a working pressure of 160 lbs. per square inch. There is no economiser, the flue gases being led direct to the chimney shaft, which is 120 ft. high from the surface of the ground and 6 ft. in diameter inside.



General View of Engine Room.

A row of bunkers opposite the boilers provides for the storage of 90 tons of coal.

Feed and condensing water are obtained from a well which has been sunk to a level below the river bed; a pipe is also carried out to the river. Two Worthington pumps, each capable of delivering 5,000 gallons per hour, raise the water to a settling-tank of 4,700 gallons capacity, from which it is pumped into the boilers. The tank is also supplied from the Southwark and Vauxhall Company's mains.

A Wheeler surface condenser of the "Admiralty" type has been installed, combined with the necessary air and circulating pumps; the feed-water is taken from a hot well in the boiler-room, and make-up water from the tank.

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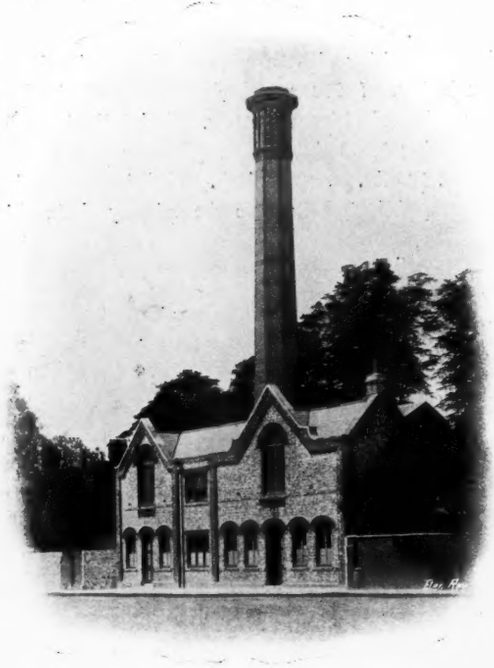
A Webster feed-water heater, made by Messrs. James Simpson & Co., Limited, receiving the exhaust steam from the auxiliary engines, raises the temperature of the feed practically to boiling point.

The whole of the steam piping, which is of steel, lagged with magnesia sectional covering, was carried out by the Babcock & Wilcox Company. Hopkinson valves are used throughout, with both dead-weight and spring safety-valves.



Front View of Works.

The main range consists of a ring main in the boiler-house, with a single pipe connection to each boiler and engine. The auxiliary engines are connected both with this and with a separate steam-pipe.

As the condensed steam is used for feed water, a Railton and Campbell oil filter is fixed close to the hot well in the boiler house; in addition, a Babcock & Wilcox oil separator, consisting of a chamber fitted with baffle plates, is inserted in the exhaust pipe close to the condenser. The steam pipes are drained by means of Geipel steam traps.

The engine-room plant was supplied by Messrs. Siemens Bros. & Co., and consists of two main generating sets, two steam balancers, and switchboard. Each of the large sets consists of a two-pole Siemens dynamo, with drum armature, coupled direct to a triple-expansion three-crank Belliss engine, and is rated at 315 amperes, 480 volts, at 420 revolutions per minute. The dynamos, however, are capable of giving 200 KW. continuously, the engines being of Messrs. Belliss and Morcom's standard 300-H.P. size.

The smaller dynamos are of similar type, coupled to compound two-crank engines made by Messrs. Belliss & Morcom, and fitted with their patent single piston valve between the cylinders; each of the dynamos is rated at 150 amperes, 240 volts, or 120 amperes at 300 volts, at 550 revolutions per minute.

Normally the steam is superheated about 100° F. at the stop valve; a thermometer pocket is provided between the separator and the governor throttle valve on one of the four engines, and a direct reading dial thermometer is fitted to each of them.

The exhaust from the low pressure cylinder of the large engines is taken off by two branches from the top and bottom of the piston valve, and is led into a main exhaust pipe beneath the floor, which opens at one end to the condenser, and at the other end to an uptake to atmosphere. There is a sluice valve at the middle to divide the exhaust pipe in two parts.

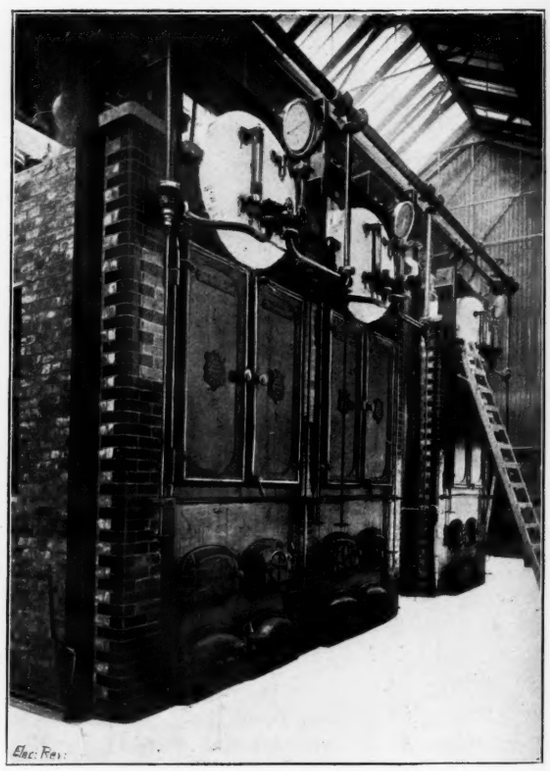
The engine room is traversed by a Chatteris 10-ton crane, operated by hand.

The switchboard provides for the generators, storage batteries and six feeders, of which five are in use. These are arranged on the plug bar system on enamelled slate panels, with four longitudinal bus bars at the back of the board. The usual complement of duplex feeder switches and fuses, maximum and minimum dynamo cut-outs and fuses, shunt regulators and balancer throw-over switches, is provided. The battery switches are of the vertical type, there being two contact bars connected by a resistance for each charge and discharge regulator, and battery main switches.

The Board of Trade panel was made by Messrs. Kelvin and White, and is equipped with a recording ammeter and an automatic cut-out, to short-circuit the ammeter in case of a dead earth occurring. With this exception, all the instruments are of Messrs. Siemens Bros.' dead-beat moving-coil type. A paralleling voltmeter, reading to 30 volts either way, is provided, and can be used for either the main generators or the balancers by the simple device of pressing a button of the bell-push type when the latter are being dealt with.

A Siemens combined wattmeter and watt-hour-meter is connected in circuit with each dynamo, and is fixed on the wall behind the switchboard; an Aron meter, with Miller's patent "discounting" modification, is in circuit with each of the batteries.

The latter consist of 274 cells, of the Electrical Power Storage Company's K type, with 15 plates, and have a capacity of 300 ampere-hours at a discharge rate of 85 amperes, or about 40 KW. The connections with the regulators are of bare copper carried on insulators, and are very neat—which is true also of the battery room as a whole. At present no charging booster has been installed, so Mr. Davidson, the resident engineer, has adopted the ingenious device of charging the regulating cells in *series* with the early evening load; when the load grows too heavy for this



Babcock Boilers.

purpose the regulators are cut out and the main batteries charged in *parallel* with the lighting load.

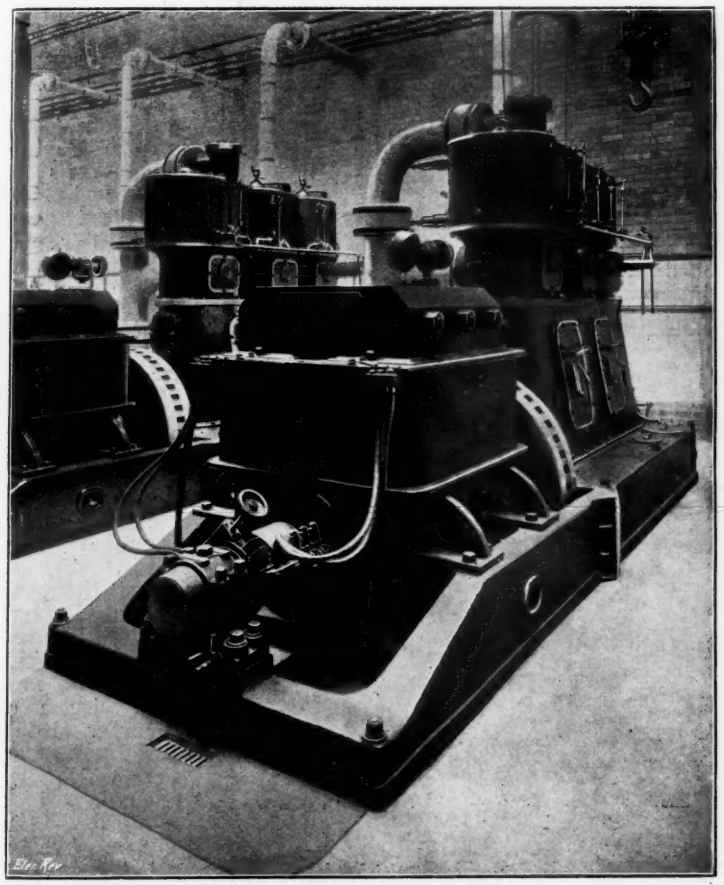
The engineer's office is provided with an enamelled slate board, equipped with two Siemens voltmeters and two Elliott recording voltmeters, which can be connected with the various feeding points by means of suitable switches. A complete outfit of instruments has been obtained for the test

room, and the workshop is to be equipped with handy tools for carrying out small repairs, &c.

The station is wired on the Simplex system, and is lighted by two Jandus lamps in series, and 50 incandescents on 210 volts inside, while a Johnson & Phillips 210-volt "Ark" lamp is fixed over the entrance.

The whole of the cables were laid by Messrs. Callender, and are of their lead-covered impregnated fibre type. The feeders are drawn into Sykes earthenware conduits, and consist of 2,000 yards triple concentric ·3, ·15, ·3 square inch; 3,100 yards, ·2, ·1, ·2; and 660 yards, ·2, ·2 square inch. The longest of these feeds an isolated network on Upper Richmond Road, on the far side of Barnes Common.

The distributors are three-core lead-covered and armoured, ·1, ·05, ·1 square inch, and are laid direct in the ground. A pilot cable with three cores of 7/20 S.W.G., lead-covered and armoured, is laid to each feeding point.



Siemens-Belliss Steam Dynamo.

A high-pressure concentric feeder, with two cores of ·25 square inch section, is laid to a point 3,100 yards distant, where a sub-station will eventually be installed. This feeder is at present working at low pressure, but when the load upon it becomes too great, a high pressure set will be installed at the works, running at about 2,000 volts, with transformers in the sub-station.

Large extensions of the mains are now in hand. At present about 5,000 8-c.p. lamps have been connected or applied for, and a rapid increase is confidently expected. Schattner meters are used thoughout on consumers' premises; these are very simple in construction, and are inexpensive, while though a consumer can "weigh up" his consumption of energy at any time, he cannot vitiate the record in any way. The prices charged are—for lighting, 6d. per unit, with a rebate for large consumers; for power, 3d. per unit.

At some future date it is intended to run a dust destructor in conjunction with the electricity works.

A peculiar state of affairs exists at Ranelagh; the club house is situated within the Council's area, but part of the grounds lies within the area of the County of London Company, which is at present supplying the house. Now, the company has a perfect right to supply energy *at* any point within this portion of the grounds, and apparently the consumer can use it on any part of his premises, the company's responsibility terminating at the feeding-point; yet the house is in another area. The question is this: Can the Council enforce its claim to supply the house? We have met with a similar case before, but so far as we know it has not come up for legal decision, and we shall look forward with interest to the solution of the problem.

As before stated, Mr. Fairley has acted as engineer to the Council in drawing up the scheme, while Mr. C. S. Davidson, who has been appointed resident engineer, rendered him valuable assistance. Mr. J. E. Anderson, Clerk to the Council, and Mr. G. B. Tomes, surveyor, have also been concerned in the success of the undertaking.

We are indebted to Mr. Davidson for facilities to photograph the station, and for his kind assistance in the preparation of this article.

THE PROPER WHEEL SECTION FOR INTERURBAN RAILWAYS.*

If high speed interurban railway cars did not have to use city tracks at their termini, the question of the proper wheel section to employ would be easy of solution. It would be a chilled iron wheel, similar to those used on steam roads, with a deep and broad flange, though somewhat lighter in weight, as the load is usually much less in electric railway service. If, however, the same car runs into a city, where the speed is necessarily low and where grooved rails or girder rails are used, confining the flange in many instances to a depth of not over $\frac{9}{16}$ in. and a thickness of $\frac{3}{4}$ in., complications immediately result. It has been found impossible to make a motor wheel of sufficient tread area to give the necessary strength to the rim and have it chilled deep enough to give the mileage exacted, without having the flange chilled through. If, then, the street railway manager is confined to a flange suitable to run on a grooved rail in the cities at a speed of, say, from 8 miles to 10 miles per hour, how can he reasonably expect that a wheel with such a flange is well adapted to a speed of 40 miles to 50 miles per hour on interurban roads? This is the question which is facing managers in all parts of the country, and it is a difficult question to solve.

There is no difficulty in making a wheel strong enough to avoid fracture at spokes, hub or rim. The problem is to make a flange of the dimensions to which the railway manager is confined by his city work, and have it strong enough to withstand the requirements of the interurban service.

The conditions of service under which motor wheel flanges are used are much more exacting than those pertaining to steam car wheels. To begin with, the flange is much shallower and thinner, and cannot be so well protected by a backing of soft iron as in the steam railroad wheels. In single-truck cars the flange of the wheel has to take all the strain of curving and the wear resulting therefrom. In turn-outs and crossings the flange often has to bear the entire load, and in some instances is worn down square; in

* *Street Railway Journal.*

others, it crumbles off at the point, as the result of such action. Again, the wheels are continually running in dirt and grit, heated up by the action of the brakes, and through water and slush; they are run down heavy grades and entered into a 45-ft. radius curve with the brakes suddenly applied; they are subjected to every conceivable kind of service under the

FIG. 1.—WHEEL WORN ON FLANGE.

management of motormen, and sometimes of officials who have but a limited knowledge of the possibilities or limitations of cast-iron, and are yet expected, under all conditions, to stand up and remain intact and give an excessive mileage at a pound price but little, if any, more than brake-shoes or sash weights. Possibly, if the characteristics of chilled iron were better understood, more care would be observed in the use of cast-iron chilled wheels.

As has been stated, to obtain the depth of chill necessary to give the mileage usually expected, the flange must be chilled through in practically all cases of city service. The chill of a wheel is composed of crystals, which are radial to the plane of the chill mould in which the wheels are cast. These crystals have a grain, or cleavage, which, under the severe heat generated by brake action, or the constant grinding of the flange against the rail in curving, separate, causing longitudinal seams, which, under continued service, extend until some sudden blow or lateral thrust causes a piece of the flange to break out. This is the principal defect that managers have to guard against, and is one to which all makers are liable. Its avoidance can be greatly furthered by a less severe application of the brakes and a more rigid tramming or squaring of the trucks. As an example of

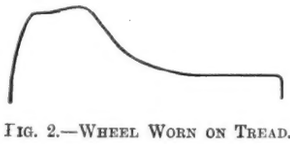


FIG. 2.—WHEEL WORN ON TREAD.

what neglect of the latter precaution may cause, attention is called to fig. 1 and fig. 2. These are sections, showing the wear of two wheels on the same axle, taken recently from an electric railway truck. An examination of these sections shows that one wheel has been constantly running against the flange, the other on the outer edge of the tread. These two wheels were made by the same molder from the same pattern on the same day, and were poured from the same ladle of iron, consequently they should have been as much alike as it was possible to be. They were also fitted accurately on the axle, as indicated by the fact that the wear in each was practically the same at all points of the circumference. Consequently the conditions of wear were

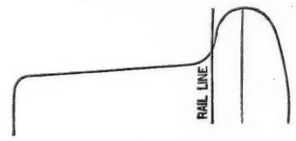


FIG. 3.—SECTION USED ON WILMINGTON-CHESTER INTERURBAN LINE.

necessarily accountable for the result, and to them should the blame be laid.

These considerations point to the necessity of having the flanges on interurban roads as deep and thick as the conditions of the urban roads will permit. Fig. 3 and fig. 4 show two sections employed on roads of this character. Fig. 3 shows a $\frac{3}{4}$-in. flange, such as is used under the interurban cars running between Wilmington, Chester and Philadelphia. As these cars start from the Pennsylvania Depôt in Wilmington, they have to run over the same tracks as do the cars used solely for urban traffic. Fig. 4 shows the $\frac{7}{8}$-in. flange, employed by the Washington, Alexandria and Mount Vernon Railway, which has to conform to the requirements of Washington city traffic. Both of the roads run cars at a high rate of speed, and the results obtained from these tread and flange sections have been quite satisfactory. The only suggestion to make in regard to these sections is that, if it were possible, it might add to the strength and life of these flanges to increase the thickness of the flange to that used by most steam roads, viz., $1\frac{3}{8}$ in.

BARNES ELECTRICITY WORKS.—MAIN SWITCHBOARD.

Speaking broadly, for interurban service, a flange depth of more than $\frac{3}{4}$ in. is not regarded by the best authorities as very important, although that in use on steam roads is now $1\frac{1}{8}$ in. Nevertheless, many of the steam roads formerly used wheels the flanges of which were little if any deeper than 1 in., and obtained good results. A few electric roads employ wheels with flanges from 1 in. to $1\frac{1}{8}$ in. deep, and from 1 in. to $1\frac{3}{8}$ in. thick, but they are used under such conditions of traffic as are exceptional, not general. If there

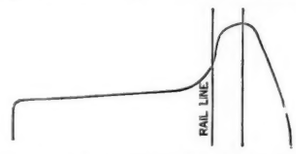


FIG. 4.—SECTION USED ON WASHINGTON-ALEXANDRIA INTERURBAN LINE.

was a regular standard rail in universal use, of a section that would permit of a thicker flange than is now generally used, the wheel troubles of the railway managers would be greatly decreased.

A few railway companies are experimenting with steel wheels for motor service. As yet the experience with their use has not been very extended, and it is impossible, therefore, to give an intelligent opinion as to their utility. It has always been the general impression, however, that the flanges of such wheels would wear rapidly in city streets, especially where there was much grit and mud on the track, and that they would have to be thrown out of service on that account long before the tread was worn out. Whether this is so or not, it may safely be said that the best remedy for wheel troubles is in the direction of adopting a standard tread and flange section that will permit the use of the thickest possible flange, consistent with urban traffic, and the issuance of positive instructions regarding the sliding and heating up of chilled wheels by brake action.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 932.)

Proposed New Zealand — Australia Cable. — The *Times* correspondent at Wellington telegraphed on May 23rd as follows:—The New Zealand-Australia State cable has been discussed between Mr. Ward and Mr. Barton. A tender has been received in New Zealand from London to lay the new cable for £220,000. Mr. Ward proposes a penny-a-word rate, which would pay handsomely. It is certain that the New Zealand Parliament will agree to lay the cable if the Commonwealth is disinclined for the partnership. The matter is being officially submitted to the Federal Government by New Zealand.

Wireless Telegraphy.— The Elder Dempster steamer, *Lake Champlain*, which sailed from the Mersey on May 21st, carried a Marconi wireless telegraphic outfit. On the 22nd, Messrs. Elder, Dempster & Co. received two telegrams from the Holyhead Post Office, sent by the apparatus from the steamer. The first, giving the position of the steamer as 8½ miles from the South Stack, had been transmitted to the station at that point. The second came from the steamer when 7 miles off Tuscar Light.

The Cunard Company will, it is understood, provide the *Lucania* with Marconi apparatus for her next passage. She is announced to leave Liverpool on June 15th.

The Marconi International Company are fitting up stations on the Welsh, Irish and American Coasts for the exchange of messages with steamers.

Prof. Slaby will read a paper on "Latest Developments in Wireless Telegraphy," at a meeting of the Verein Deutscher Ingenieure to be held at Kiel, Germany, on June 10th.

The Prince of Monaco left Monaco on Monday on board his yacht, the *Empress Eugene*, in order to carry on experiments in wireless telegraphy at Biot, near Antibes. On board the yacht are the Governor-General, Captain Baron de Gail, M. de Maleville, General N. Marconi, and several other guests.

The *St. James's Gazette* says that the French are about to take a new departure in regard to submarine boats. An effort is to be made to establish communication by means of wireless telegraphy between a station on shore and a submerged vessel 10 miles distant.

CONTRACTS OPEN AND CLOSED.

OPEN

Brazil.—July 8th. The Foreign Secretary has received a despatch from H.M. Consul-General at Rio de Janeiro, stating that tenders are invited by the Brazilian Government, to be received not later than July 8th, for the supply of electrical machinery for the hoisting and transporting of locomotives at the Engenho de Dentro Works. Some particulars may be examined at the Commercial Department of the Foreign Office.

Dublin.—June 3rd. The Lighting Committee wants tenders for switchboards, transformers, arc lamps and posts. See "Official Notices" May 10th.

Dublin.—June 3rd. The Lighting Committee wants tenders for motors and motor-generators, battery, meters, and wiring the works. See "Official Notices" May 17th.

Dundee.—June 5th. The T.C. wants tenders for the overhead equipment of the Seagate route. See "Official Notices" May 24th.

Eastbourne.—June 7th. The Corporation wants tenders for 400 alternating meters, also 200-volt lamps. See two "Official Notices" May 24th.

Eastbourne.—June 8th. The Corporation wants tenders for economiser, feed heater, piping, tank, and crane. See "Official Notices" May 24th.

Edinburgh.—June 12th. The Council wants tenders for electric lighting installation at the Colinton Mains Fever Hospital. See "Official Notices" May 17th.

Edinburgh. — June 15th. The Corporation wants tenders for ash conveying plant for Dewar Place station. See "Official Notices" May 24th.

Exeter.—June 14th. The Council wants tenders for water-tube boilers, steam alternators, switchboards, coaling apparatus, tanks, &c. See "Official Notices" May 10th.

Farnworth.—June 7th. The U.D.C. wants tenders for the overhead equipment of five miles of tramways, and tramway poles. See "Official Notices" May 24th.

France.—June 10th. The municipal authorities of Ardres (Pas de Calais) are inviting tenders until June 10th for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, La Mairie d'Ardres (Pas de Calais).

Glasgow.—June 10th. The Corporation wants tenders for branch rubber-covered cables. See "Official Notices" May 24th.

Glasgow.—June 10th. The Corporation wants tenders for electricity meters. See "Official Notices" May 17th.

Hendon.—June 5th. The U.D.C. wants tenders for the wiring of the new Council offices. See "Official Notices" May 3rd.

Huddersfield.—June 4th. The Corporation wants tenders for five mechanical stokers. See "Official Notices" to-day.

Ipswich.—June 8th. The Corporation wants tenders for dryback marine type boilers 11 ft. 6 in. × 14 ft. long. See "Official Notices" May 17th.

Islington.—June 11th. The Lighting Committee wants offers for "free" or "assisted" wiring; also for painting arc lamp columns. See "Official Notices" May 24th.

London.—June 12th. The Central Electric Supply Company wants tenders for three 20-ton and one 10-ton travelling cranes. See "Official Notices" May 24th.

London.—June 12th. The East Indian Railway Company is in the market for electric overhead travelling cranes. Specification to be seen at the company's offices. Tenders to Mr. C. W. Young, Secretary, Nicholas Lane, London, E.C.

London.—June 17th. The Guardians of St. Marylebone wants tenders for electric light, wiring and fittings for the new Able Bodied Block of their workhouse. See "Official Notices" to-day.

Madrid.—June 1st. The Secretary of State for Foreign Affairs has received a despatch from H.M. Ambassador at Madrid stating that tenders are invited by the Spanish Postal and Telegraph Department for the supply of 30,000 zinc cylinders for the service of the Government telegraph stations. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office.

Manchester. — June 4th. The Tramways Committee wants tenders for electrical fittings for lighting the Queen's Road car shed. See "Official Notices" May 24th.

Poplar.—June 4th. The Electricity Committee wants tenders for a storage battery. See "Official Notices" May 24th.

Rochdale.—June 7th. The Corporation wants tenders for six specimen electric tramcars. See "Official Notices" May 24.

Spain.—June 10th. The Spanish Post and Telegraph department is inviting tenders until June 10th for the supply of 21 tons of copper sulphate for the telephone service. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Madrid.

Sunderland. — May 31st. The Corporation wants tenders for coal bunker and overhead gantry for electricity works. See "Official Notices" May 17th.

Taunton.—June 11th. The Corporation wants tenders for one 250-KW. steam alternator, one 15-KW. motor-generator, switchboard extensions, water-tube boiler superheater, condensing plant, piping, &c. See "Official Notices" May 24th.

Uxbridge.—June 2nd. The Uxbridge and District Electric Supply Company, Limited, invites tenders for the erection of a generating station at Uxbridge.

Walthamstow.—June 14th. The U.D.C. wants tenders for electric light meters. See "Official Notices" to-day.

Warrington.—June 13th. The Corporation invites tenders for boiler, 500-KW. engine (Willans) and dynamo, and mains, &c. See "Official Notices" May 24th.

the tread. These two wheels were made by the same molder

York.—June 10th. The directors of the North-Eastern Railway wants tenders for the undermentioned articles, during the six months ending December 31st, 1901:—(1) Telegraph apparatus; (2) Telegraph wire and line stores. Payment for each month's delivery will be made at the end of three clear months, or in cash, less 2½ per cent. discount. Forms of tender may be obtained on application to Mr. Graves, Telegraph Department, York.

CLOSED.

Bristol.—The Electrical Committee has placed contracts as follows:—Babcock & Wilcox for pipe work; S. Z. de Ferranti, Limited, for power switchboard and feeder panels; British Electric Transformer Company, for transformers.

Lancaster.—The Corporation have contracted with the British Westinghouse Electric Manufacturing Company, for a 200 KW. set (engine and dynamo) for £2,250, the machinery to be delivered in five months. If the plant does not prove suitable it will be replaced. Some exception was taken to this firm getting the order, because of its foreign association, but it was stated that they are at present erecting works near Manchester.

Manchester.—We learn that the Electrical Company, Limited, of Charing Cross Road, have secured the order from the Manchester Corporation for six three-phase generators of 2,500 H.P. each and sub-station motor transformers.

Metropolitan Asylums Board.—The *City Press* says that the Lancashire Dynamo and Motor Company, Limited, whose tender, at the sum of £6,399, for electric generating plant was accepted by the managers at their last meeting, having withdrawn their tender in consequence, as they stated, of "a serious mistake in pricing out the estimate," the Works Committee recommended: "That the tender of Crompton & Co., Limited, for the supply and fixing of electric generating plant at the Tooting Bec Asylum, of £6,650, be accepted." This was agreed to.

Partick.—The Council has contracted with Messrs. Mechan & Sons for a main switchboard and instruments at £1,350, and with the Tudor Accumulator Company for a battery at £2,396.

FORTHCOMING EVENTS.

Friday, May 31st.—At 5 p.m. Physical Society. Meeting at the rooms of the Chemical Society, Burlington House. Agenda:—(1) "On a Model which imitates the behaviour of Dielectrics," by Prof. Fleming, F.R.S., and Mr. A. W. Ashton, B.Sc. (2) "On the Resistance of Dielectrics and the Effect of an Alternating Electromotive Force on the Insulating Properties of India-rubber," by Mr. Ashton. (3) "Note on the Electrification of Dielectrics by Mechanical Means," by Mr. Ashton.

Thursday, June 6th.—At 8.30 p.m. Röntgen Society. Paper by Dr. Hugh Walsham on "X Ray Diagnosis of Aneurism," with lantern demonstration.

At 3 p.m. Royal Institution. Prof. Dewar, F.R.S., will deliver his final lecture on "The Chemistry of Carbon."

NOTES.

The National Electric Light Association, U.S.A.—This Association held its annual convention last week, and among the papers read during the three days were the following:—

Address by President Cahoon. Paper, by C. R. Van Trump, on "A Station Load Diagram." Paper, by Francis W. Willcox, on "The Practical Side of the Incandescent Lamp." Report of the Committee on Standard Candle-Power of Incandescent Lamps," Dr. Louis Bell, chairman. Report of the Committee on Amendments to Freight Classification of Electrical Apparatus, James I. Ayer, chairman. Paper, by H. W. Hillman, on "Arc Lighting at the Beginning of the Twentieth Century." Report of the Committee on Photometric Value of Arc Lamps, Henry L. Doherty, chairman. Paper, by Louis R. Wallis, on "The Foresee (4-C) System of Charging." Report of the Committee on Uniform Accounting, G. E. Tripp, chairman. Report of the Committee on Analysis of Flue Gases, Henry L. Doherty, chairman. Executive Session—Report of the Committee on Legislative Policy, Samuel Insull, chairman. Paper by Augustus Treadwell, jun., on "Storage Batteries in Central Station Work." Report of the Committee on Rules for Electrical Construction and Operation, Captain William Brophy, chairman. Topic, "Steam Heating from Central Stations." Paper by Calvin W. Rice on "Distribution of Current at High Potential in New York City."

conditions of traffic as are exceptional, not general. If there

Fire Prevention New Testing Station.—The new testing station of the British Fire Prevention Committee was opened on Wednesday last week. Mr. Edwin O. Sachs presided, and was supported by Major-General Festing (South Kensington Museum), and Mr. H. H. Collins (Past-President District Surveyors' Association), on behalf of the Council. Among those present were a large number of public officials, including officers from the Royal Arsenal at Woolwich, from Chatham, representatives of the Admiralty, big railway and insurance companies and leading fire brigades, whilst a very large number of district and local surveyors also took the opportunity of visiting the station. The following tests were undertaken in the course of the afternoon: One with a suspended ceiling protecting an ordinary floor, and another with a thin partition, both by the Banks' Fireproof Construction Syndicate, Limited, which were subjected to high temperatures for a period of 1½ hours. Further, a very important test was undertaken with a heavy warehouse floor, spanning 22 ft., which was subjected to a very severe test for a period of 3 hours whilst loaded to the extent of 2 cwt. per square ft.; this floor was put forward by the same syndicate for investigation. Electrical firms of good standing would not be ill-advised in becoming members of the British Fire Prevention Committee.

National Electrical Contractors' Association.—An enthusiastic meeting of the promoters and supporters of this scheme was held at the offices of the secretary on Tuesday afternoon, Mr. H. Bland, of Newcastle and West Hartlepool, acting as chairman. The secretary read apologies for absence from well-known contractors in London and the provinces, all of whom were in hearty sympathy with the movement, and promised their support. The report of the Provisional Committee, appointed at the first meeting, was read and approved, after which the chairman delivered a most interesting and exhaustive address, dealing with the needs for such an association, and the good work which had already been done by the local associations in existence up and down the country. The meeting was thrown open for discussion. Encouraging reports were made by representatives from provincial associations, and a number of points affecting the well-being of the Association were thoroughly ventilated. The following resolution was carried unanimously, viz.:—

Having regard to the desirability of forming a National Association for the purposes, *inter alia*, of protecting and consolidating the interests of electrical contractors in Great Britain and Ireland, it is hereby moved that the representatives of local associations and others present at this meeting hereby form themselves into an association, to be called the National Electrical Contractors' Association.

A large and influential General Committee, representative of England, Scotland, and Ireland, was appointed, and it will be one of the duties of this Committee to use its best influence in forming local associations in centres where they do not already exist, so that the movement may become universal throughout the United Kingdom. Electrical contractors in London and the provinces who have not yet identified themselves with the movement are desired to communicate with the secretary, Mr. Thos. Guthrie, C.A., 46, Queen Victoria Street, London.

Accidents.—On Saturday the employés of Callender's Cable Company were holding a club regatta off Belvedere, on the Lower Thames. During the final race, a heavy squall setting in from the Essex shore, one of the boats was swamped and two men named Moir and Cobb were drowned.

During the process of casting plates at the Chloride Battery Works at Clifton Junction on Friday last, an iron table tilted and crushed one of the workmen, whose life is despaired of.

Marriage.—We read in the marriage announcements in the *Times* that on the 20th inst., at the English church, Naples, J. Fletcher Moulton, K.C., M.P., of 57, Onslow Square, was married to Mary May, daughter of Major Henry-Davis, of The Villa, Floridiana, Naples.

The Paris Electric Cab Failure.—The Paris correspondent of the *Financial Times* gives the following interesting and important notes regarding the result of the running of electric cabs in Paris. No doubt most of our readers remember the causes which led to a similar pass in respect of the London electric cabs:—

The most important cab company in Paris, the Compagnie Générale des Voitures, after spending a considerable sum in experimenting, placed a number of electric motor cabs on the Paris streets towards the end of 1899. These cabs continued to ply for hire until November last, when they suddenly disappeared from the streets. It appears from the report read at the recent annual general meeting of the company, that the experiment has proved altogether unprofitable, and that a sum of £180,000 had been sunk in the attempt to introduce motor cabs. M. Bixio, president of the company, explained that the directors had been quite sure of success, and that the failure of electric motor cabs to produce the results expected was a sore disappointment. The causes for the failure of the experiment are various. In the first place, the cost of maintaining the accumulators, which were of the most approved type, turned out in practice to be much greater than previous trials had led the directors to anticipate. Then, again, the fares charged were very high, and, as a matter of fact, during the greater part of the time they were on the streets, the cabs were not used by the public for business purposes, but mostly by the *clientèle* of the big hotels, the clubs, &c., for pleasure trips to the Bois de Boulogne. The experiment was made on a large scale, with well-equipped workshops and charging stations, quite apart from the ordinary cabyards belonging to the company. Of the £180,000 sunk in the experiment, some £60,000 is totally lost, and the remaining £120,000 was so far at risk, that the directors decided in November to call in the cabs and close the workshops.

Electric Freight Railways.—Continuing his articles in *Traction and Transmission*, Mr. Gibbings enters a special plea for his South Lancashire scheme, the gist of which is the substitution of electrical vehicles for horse lorries, the running of these along the dock side, their loading and immediate dismissal as though they were horse vehicles, and their departure to Manchester and elsewhere. The idea has its merits. It avoids the laborious marshal of many trucks into a long freight train; it expedites delivery so far as it economises the period of making up a train; avoids the congestion at a goods yard, and also avoids some handling. But there are difficulties which seem to have been overlooked. A large number of drivers will be wanted for the individual trucks. There will still be much terminal handling unless a track is laid into every works with electric wires complete; freight trains ought already to be able to be loaded at the dock side, and so save the handling in and out of lorries, as is the practice at Liverpool; but certainly self-moving trucks would enable this part to be done better than with dead trucks and steam locomotives. We admit there is no such area in the world as South Lancashire for traffic and population, and it is an area by no means over-provided with facilities; however, the faults are not altogether inherent to the present steam system, but are due to Liverpool laxity. There was no reason why Liverpool docks should not have been fully provided with facilities, and there is absolutely no justification for the freight charges of the railroads. They should be halved. Thus, in Mr. Gibbings's estimate of savings, there should not properly be included the cartage at Liverpool, for this is not due to the use of a steam system. He thinks it possible to make a good profit at half the present charges, which amounts very much to saying that with an excellent rate per ton mile, money can be earned, for even 2d. per ton mile is not half the existing extortion. Mr. Gibbings really bases his figures on a revenue of 1s. per car mile, though a full 10-ton load would earn 20d. The public benefit from the scheme is claimed in the reduced road repairs. With all goods on a tramroad, the regular road surface would be devoted chiefly to the lighter traffic and the gentle bicycle. As a reminder of what a general goods tramway may do, it is pointed out that there are many collieries in the district sending out 500 and 1,000 tons per week for local use only, a usual charge for which is 10d. per ton mile. This argument, however, must not be unduly pressed in an electrical freight scheme, for it is quite as obvious that such collieries might well burn all their output at the pit's mouth and send away all their coal—in a sense—along a copper wire. Considering the necessities of ventilation, it even occurs to us that coal need never be brought to the surface at all. It might be loaded at once into underground gas producers and made to work its own passage to the surface, though, except for the shallow mines, there are obvious difficulties in the cost of the shafts and excavations. Still, there is no reason for any coal to go far beyond the pit bank.

Permanent Secretary to the Board of Trade.—It is announced that the President of the Board of Trade has appointed Mr. Francis J. S. Hopwood, C.B., C.M.G., to be the Permanent Secretary to the Board of Trade in the place of the late Sir Courtenay Boyle, K.C.B. When, in 1893, Sir Courtenay Boyle succeeded Sir Henry Calcraft as Permanent Secretary, Mr. Hopwood was appointed secretary to the Railway Department. In that department he has been especially connected with legislation for the promotion of light railways, the development of electric traction, and other kindred matters.

Electric Lighting and Insurance.—At the annual meeting of the National Board of Fire Underwriters held in New York City recently, Mr. F. C. Moore, of New York, chairman of the Committee on Light, Heating and Patents, brought the attention of the board to the question of the life of electrical devices. He said, according to the *Electrical World*, that the president of a Western insurance company estimates that 25 per cent. of the losses of the past year are due to these devices. He said that he had submitted a number of questions relating to electrical devices and their dangers to prominent electrical engineers throughout the country, but as yet had not received answers from all of them. Mr. Moore said that an inspection of the devices at the Pan-American Exposition disclosed the fact that there was considerable defective wiring, and that a number of "mud" tubes had been used instead of porcelain tubes. Mr. Moore added that orders had been given for the necessary repairs.

The Institution of Electrical Engineers (Dublin Section).—The following is a list of the Committee for 1901—1902:—Prof. W. F. Barrett, F.R.S., chairman; Mr. J. W. Towle, vice-chairman; Messrs. C. A. Burge, C. P. C. Cummins, F. Gill, Mons. G. Molloy, D.D., D.Sc., A. E. Porte, W. Tatlow, P. S. Sheardown, F. T. Trouton, D.Sc., F.R.S., G. F. Pilditch, M. C. Olsson.

The annual general meeting of the Section was held on 23rd inst. Mr. F. Gill, hon. sec., read the report of the Committee. Mr. W. Tatlow, M.A., B.E., associate member, then read a paper on "The Arrangement of Accumulators in a Small Installation."

Motor Lorries Wanted.—With a view to obtaining the best self-propelled lorry for military purposes, the Secretary of State for War offers three prizes, a first prize of £500, a second prize of £250, and a third prize of £100 for the three self-propelled lorries which shall be adjudged, after a series of trials carried out by the War Office Committee on Mechanical Transport, to be best suited to military requirements. The trials will commence on December 4th next, and will extend over a considerable period. Those wishing to enter for this competition must send in their names to the secretary, Mechanical Transport Committee, War Office, Horse Guards, Whitehall, by September 1st next.

Institution of Electrical Engineers.—The provisional arrangements for the Institution visit to Germany have now been announced to members. The party will start on the evening of Saturday, June 22nd, for Hanover and Berlin. The official visit to Berlin will terminate at midday, Thursday, June 27th, but the tour may be extended to Sunday, June 30th, or to Friday, July 5th, in which case Dresden (June 30th), Nuremberg, Frankfurt and Cologne will be included in the programme. Full particulars can be obtained from the secretary, Mr. W. G. McMillan. All applications must be lodged before June 15th.

Newport Electric Lighting.—A meeting of the ratepayers of Newport, convened by requisition of the Mayor, was held to discuss the question of the expenditure by the Corporation on electricity. It was stated that at the last meeting the Corporation had accepted tenders for close on £50,000, in connection with the proposed new power station in Corporation Road. Mr. A. J. Stevens, J.P., said that the machinery at the present works was obsolete when put down, and that alternating plant was a mistake at Newport. He suggested that a private company should be allowed to work the proposed new electric tramways. Mr. G. H. Llewellyn, late chairman of the Electricity Committee, stated that all the power necessary for the next 20 years could be provided for in the present station. There was room there for extensions. A day load should be obtained from the machinery, which was now worked eight hours a day, so that the price could be reduced from 6d. to 4d. per unit. A vote of confidence in the council was defeated by 258 votes to 145, and a resolution asking the Corporation to rescind the resolution passed at their last meeting was carried by a large majority. A poll of the ratepayers is the probable sequel to the proceedings.

Liberal Lancaster.—At the meeting of the Lancaster Town Council on Wednesday, an amendment was raised on the minutes of the Electricity Committee who recommended that £20 be voted towards the expenses of Mr. W. A. Fraser, the engineer who recently fought with the Middlesex Yeomanry in South Africa. Mr. Fraser spent £50 in order to keep his promise with the Corporation to return in 12 months, but the Town Council changed in character while he was at the front, and the new committee engaged another engineer. Mr. Fraser, on coming home, found himself in a secondary position, and quickly migrated to Nelson at a salary of £300 per annum. Mr. Helme, M.P., a Liberal Imperialist, urged the Council to accept the recommendation of the Committee and keep their promise to treat Mr. Fraser as they desired other employers should treat men at the war. However, the amendment was carried.

Personal.—The Barnes District Council has raised the salary of Mr. Davidson, the electrical engineer, to £200 per annum.

Mr. E. T. Williams, assistant borough electrical engineer, King's Lynn, has been appointed to the position of engineer-in-charge at the Belfast Corporation electricity works.

Mr. Arthur G. Bird has resigned the post of station superintendent at the Bristol electricity works, having been appointed engineer and manager of the Guernsey Electric Supply Company. Mr. J. H. Bolum, B.Sc., has been promoted to Mr. Bird's position at Bristol.

Mr. Edward A. O'Keefe, who has been for so many years Senior Demonstrator in the Electrical Engineering and Applied Physics Department of the Finsbury Technical College, under Prof. Silvanus P. Thompson, has been unanimously selected to fill the post of Head Science Master and Organising Secretary of the Crawford Municipal Technical Institute, Cork. The Institute will, no doubt, be modelled on the lines which have proved so successful at Finsbury.

Belleville Boilers.—The *Pall Mall Gazette* correspondent says that, "Ever since the ship has been in commission, a great deal of trouble has been given by the Belleville boilers of H.M.S. *Terrible*. Letters just received from the China station say that the cruiser's boilers become worse instead of better: in fact, are giving so much trouble that the ship will be sent home as soon as she conveniently can be. At Portsmouth the work of completing the *Powerful*, the *Terrible's* sister ship, is being pushed on. It is quite understood that she will go back to China in relief of the *Terrible*. But neither ship is ever likely to show the British taxpayer value for his money. By reason, primarily, of their Belleville boilers both ships are so frequently under repair that the cost of keeping them in a sea-going condition is enormous."

Appointments Vacant.—A director of technical education is required for the Carlisle Corporation's library, museum, art gallery and technical schools, at £250 per annum and 10 per cent. on grants. Applications are also being invited for an organising chair in connection with the future Faculty of Commerce at Birmingham University, the stipend being £750 per annum. The chair of mechanical engineering at University College, Birmingham, will be vacant shortly by the resignation of Prof. Hudson Beare, who goes to Edinburgh. A resident electrical engineer is wanted for Epsom at £3 per week. An electrician-in-charge is wanted for Canterbury electricity works at £78 per annum. A shift engineer is wanted for Manchester electricity works at £150 per annum. Two junior assistants and others are required for Birkenhead. An engineer-in-charge is wanted for seven weeks for the Southwark Electricity Works. A shift engineer is required for King's Lynn, and a chief clerk for the Wimbledon Electricity Department. For fuller details of some of these appointments see our "Official Notices."

Glasgow Tramways.—We are informed that the Allis-Thomson-Houston sets have been undergoing output tests during the past week. One of the two sets during a recent visit was giving out 4,500 B.H.P. at a speed of 71 revolutions per minute. The normal speed is 75. Temporary three-phase connections were run into the canal which lies close by, and formed an admirable water resistance. The nominal power of the engines is 4,000 H.P., but it was stipulated that they were to be of 5,000 B.H.P. for emergencies.

Manchester Tramways.—The inauguration of the electric tramcar service of the Manchester Corporation will take place on June 6th on the Cheetham Hill and Albert Square route.

English Mechanics Abroad.—It is stated in the *Daily Mail* that 28 mechanics from Birmingham are about to visit the Zurich Polytechnic for the purpose of studying the latest methods in the manufacture of electrical machinery.

NEW COMPANIES REGISTERED.

Drake & Gorham, Limited.—This company was registered on May 22nd, with a capital of £125,000 in £1 shares, to acquire the business of electrical, mechanical and hydraulic engineers carried on by B. M. Drake and J. M. Gorham at 66, Victoria Street, S.W., as "Drake & Gorham," with the tenancy agreements of the premises where such business and its branches are carried on, and certain patents for use in the said business, to adopt an agreement with the said B. M. Drake and J. M. Gorham, and to carry on the business of electrical, mechanical and hydraulic engineers, &c. The first subscribers (each with one share) are:—B. M. Drake, 66, Victoria Street, S.W., electrical engineer; J. M. Gorham, 66, Victoria Street, S.W., electrical engineer; M. G. Drake, 66, Victoria Street, S.W., electrical engineer; R. P. Sellon, Britton Hill, Sanderstead, Surrey, electrical engineer; A. Payne, 66, Victoria Street, S.W., electrical engineer; J. C. Forster, Clatford Mills, Andover, gentleman; and A. C. Read, 66, Victoria Street, S.W., gentleman. Minimum cash subscription, £85,000. The number of directors is not to be less than three nor more than seven; the first are Bernard M. Drake and John M. Gorham and two others to be appointed by the subscribers; qualification, £200; remuneration, £200 each per annum (£300 for the chairman) and a share in the profits. Registered office, 66, Victoria Street, S.W.

Birkdale District Electric Supply Company, Limited (70,259).—This company was registered on May 21st, with a capital of £30,000 in £5 shares, to carry on in the United Kingdom and elsewhere the business of electrical engineers and contractors, suppliers of electricity, carriers of passengers and goods, electricians, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic, and other apparatus, mechanical and chemical engineers, suppliers of light, heat, sound and power, &c., to acquire any inventions relating to the propulsion of cars, trucks, boats, and vehicles by electricity or otherwise, and to construct railways and tramways and work the same by electricity, steam, oil, gas, horse, or other power. The first subscribers (each with one share) are:—J. S. Raworth, Donington House, Norfolk Street, W.C., civil engineer; E. Garcke, Donington House, Norfolk Street, W.C., managing director of British Electric Traction Company, Limited; C. H. Dade, Donington House, Norfolk Street, W.C., secretary; I. V. Kitchener, 19, York Place, Oxford Road,

Manchester, district superintendent of British Electric Traction Company, Limited; W. J. Greer, Donington House, Norfolk Street, W.C., engineer; H. Colbourne, Donington House, Norfolk Street, W.C., secretary: and W. L. C. Madgen, Surrey House, Victoria Embankment, W.C., managing director of Electrical Power Distribution Company, Limited. No initial public issue. The number of directors is not to be less than three nor more than seven; remuneration, £50 each per annum and a share in the profits. Registered office, Donington House, Norfolk Street, W.C.

Dolter Electric Traction Company, Limited (70,261).—This company was registered on May 21st, with a capital of £100,000 in £1 shares, to acquire any inventions, licenses, concessions and the like relating to the production, treatment, storage, application, distribution, and use of electricity, in particular to acquire from the Société d'Exploitation des Brevets Dolter, of 12, Rue La Fayette, Paris, the benefit of certain existing British, Indian, and Colonial patents, and other patents and patent rights obtainable in the British Empire in respect of certain inventions relating to electric traction or apparatus therefor, and to carry on the business of an electric traction and supply company, and of tramway and railway proprietors, electricians, engineers, suppliers of electricity, smiths, wire drawers, electro-platers, packing case makers, builders, carpenters, joiners, wagon and van proprietors, promoters, concessionaires, &c. The subscribers (each with one share) are:—H. Reynolds, 20, Great Winchester Street, E.C., clerk; G. Saunders, 103, Ashmore Road, Paddington, W., clerk; A. Basilio, 57, Middle Lane, Hornsey, N., accountant; W. H. Roe, 24, Sedgmoor Place, Camberwell, S.E., clerk; H. E. A. Shearer, 66, Arnott Road, East Dulwich, S.E., clerk; H. W. Fordham, 8, Chapel Place, Long Lane, Southwark, S.E., clerk; and J. H. Critchley, 19, Dartmouth Park Road, N.W., clerk. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are Emile Garcke, Charles S. Drummond, Hugh N. Lubbock, and Tom O. Callender; qualification, £100; remuneration, £100 each per annum (£50 extra for the chairman), and a share in the profits. Registered office, Donington House, Norfolk Street, Strand, W.C.

Electrical Productions, Limited (70,093).—This company was registered on May 6th, with a capital of £3,000 in £1 shares, to carry on the business of manufacturers of and dealers in wires, cables, and lines of all kinds, electricians, electrical, mechanical, gas, and general engineers, manufacturers of and dealers in all apparatus and things required for, or capable of being used in connection therewith, machinists, fitters, &c. The first subscribers (each with one share) are:—R. T. Smith, Carey Street, W.C., solicitor; J. D. F. Andrews, 75, Fulham Park Gardens, S.W.; Mrs. A. B. Andrews, 75, Fulham Park Gardens, S.W.; W. Tozer, 13, St. Helen's Place, E.C., merchant; F. Walker, 2, Pembridge Villas, Putney, mechanic; E. W. Spears, 147, Westferry, Millwall, mechanic; and G. E. Winter, 60, Caversham Road, N.W., electrician. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first.

D. F. Laing & Co., Limited (4,847).—This company was registered at Edinburgh on May 8th, with a capital of £2,500 in £1 shares, to acquire the business carried on by Messrs. D. F. Laing & Co., at 47, South Portland Street, Glasgow, and to carry on the business of electrical engineers, &c. The first subscribers are:—Archibald Low, Partickhill, Glasgow, coppersmith, with 25 shares; Robert Wilson, 180, Hope Street, Glasgow, solicitor, with 25 shares; John Wardhaugh, 180, Hope Street, Glasgow, chartered accountant, with one share; Thomas Logan, 4, Bath Street, Glasgow, accountant, with one share; P. S. Laing, 4, Bath Street, Glasgow, accountant, with one share; William Pollock, 56, Cadder Street, Pollockshields, law clerk, with one share; and D. F. Laing, 47, South Portland Street, Glasgow, electrician, with 25 shares. The number of directors is not to be less than three nor more than seven. The first are Archibald Low, Robert Wilson and D. F. Laing. Qualification, 25 shares; remuneration not to be less than £10 10s. each per annum and £15 15s. for the chairman. Registered office, 4, Bath Street, Glasgow.

Millington, Everitt & Co., Limited (70,210).—This company was registered on May 15th, with a capital of £3,000 in £1 shares, to carry on the business of electricians, suppliers of electricity, manufacturers of and dealers in electric motors, dynamos and starting and regulating switches, and electric, galvanic and magnetic apparatus of all kinds; contractors for the installation of electric light, heat, motive power, and other electric agents or facilities, suppliers of light, heat and motive power, electrical and general engineers, motor carriage manufacturers, cycle, bicycle, tricycle and velocipede builders, &c.; and in particular to acquire from F. Millington, of 16, Market Hill, Cambridge, the benefit of certain existing inventions relating to electric motors, starting, resistance and ampere meters, and all patents connected therewith, and any improvements thereon. The first subscribers are:—Frederick Millington, 16, Market Hill, Cambridge, electrical engineer, with 200 shares; Thomas Newton, 20, Regent Street, Cambridge, plumber, with 200 shares; Mrs. Mary Everitt, 16, Market Hill, Cambridge, with 10 shares; Harriet Rooke, 3, Silver Street, Cambridge, with 5 shares; Thomas L. Barker, 139, Victoria Road, Cambridge, engineer, with 1 share; Arthur E. Everitt, 16, Market Hill, Cambridge, electrical engineer, with 6 shares; and Miss J. A. Stealing, 5, Silver Street, Cambridge, with 5 shares. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are F. Millington and T. Newton. Qualification, £50; remuneration as fixed by the company. Registered office, 20, Regent Street, Cambridge.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bromley (Kent) Electric Light and Power Company (54,127).—This company's annual return was filed on April 17th, when 1,939 shares were taken up out of a nominal capital of £50,000 in 10,000 shares of £5 each; £9,670 has been paid; £25 remains in arrears; mortgages and charges, £20,000.

National Electric Wiring Company (53,364).—This company's annual return was filed on May 8th, when 118,971 shares were taken up out of a nominal capital of £250,000 in £1 shares; 15s. per share has been called up on 100,120, resulting in the receipt of £74,768 15s.; £321 5s. remains in arrears; 18,851 shares considered as fully paid; no mortgages or charges.

Guildford Electricity Supply Company (36,725).—Particulars of registered mortgages and charges:—Total amount secured by series of debentures, £15,000: date of resolution creating series of debentures, November 19th, 1900; dates and amounts of debenture issues (*a*) January 16th, 1901—£1,400; (*b*) March 21st, 1901—£2,100. Property charged: The whole undertaking and property of the company. Trustees (none). Dates of registration (*a*) January 22nd, 1901; (*b*) March 25th, 1901.

County of London and Brush Provincial Electric Lighting Company (34,320).—Particulars of registered mortgages and charges:—Date of resolution creating series of debentures, January 23rd, 1899; total amount secured by series of debentures, £400,000; date of debenture issue, April 4th, 1901; amount of debenture issue, £100,000. Property charged: The undertaking and property, present and future, of the company. Trustees: The Electric and General Investment Company, Limited. Date of registration: April 22nd, 1901.

Hove Electric Lighting Company (36,942).—This company's annual return was filed on April 10th, when 12,000 shares were taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each, £5 has been called upon each of 11,000 shares, and £3 on each of 1,000, resulting in the receipt of £57,895, in addition to which £217 10s. has been paid in advance of calls. £105 remains in arrears. Mortgages and charges £25,000.

Willans & Robinson, Limited (20,060).—This company's annual return was filed on April 29th, when 50,000 preference and 50,000 ordinary shares were taken up out of a nominal capital of £750,000 in 75,000 preference and 75,000 ordinary shares of £5 each. £5 per share has been called up on 25,537 preference and 25,538 ordinary, and £3 per share on 10,000 preference and 10,000 ordinary, resulting in the receipt of £315,375, in addition to which £235 has been paid in advance of calls. 14,463 preference and 14,462 ordinary shares are considered as fully paid. Mortgages and charges £100,000.

City of London Electric Lighting Company (34,406).—This company's annual return was filed on April 30th, when 40,000 preference and 70,595 ordinary shares were taken up out of a nominal capital of £1,200,000 in 40,000 preference and 80,000 ordinary shares of £10 each; £1,105,950 has been paid; mortgages and charges, £600,000.

SUPPLY STATION ACCOUNTS.

Hastings Corporation Electricity Accounts.

Hastings is, as we forecasted when last dealing with the accounts, rapidly coming into line with other South Coast undertakings, and the results of last year's working are very favourable as regards the increase in output. The average yearly increase in sale of energy for private supply during the previous four years was about 35,000 units, whereas last year it reached nearly four times this figure. The public lighting has for the past few years remained almost stationary at 53 arc lamps of 600 watts. As private consumers were not too readily obtained during the closing years of the company's management, the growth of the business must be gratifying to Mr. Leonard Andrews, the borough electrical engineer. The load is rising, last year the increase was over 33 per cent., but as the plant installed amounts to 785 kw., and the call last year was less than 500 kw., with the rearrangement of the works, progress ought to be satisfactory with but a slight increase in capital expenditure.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£78,916	£102,256	£23,340
Number of units sold	404,866	524,830	119,964
Number of 32-watt lamps connected	17,723	23,864	6,141
Maximum load in kw.	360	495	135
Gross revenue	£11,702	£11,883	£181
Gross expenditure	£6,383	£7,987	£1,604
Gross profit	£5,319	£3,896	−£1,423
Average price per unit sold ...	6·76d.	5·18d.	−1·58d.

dition is enormous."

pany, Limited; C. H. Dade, Donington House, Norfolk Street, W.C., secretary; I. V. Kitchener, 19, York Place, Oxford Road,

From the figures given below it appears that consumers have benefited by the substantial reduction of over 1½d. per unit sold. The prices now charged are either 6d. per unit on a flat rate, or £15 per annum per KW. demanded with a charge of 1½d. per unit taken. The distribution of the units was:—

Year.	Units generated.	Units sold. Public lighting.	Cost of public lighting.	Units sold. Private supply.	Number of arc lamps.
1898	521,094	124,098	£2,476	239,580	53
1899	542,619	123,000	£2,650	281,866	53
1900	687,503	123,000	£2,856	401,830	53

The cost of public lighting includes energy £2,650, and attendance, repairs, &c., £206.

REVENUE STATEMENT.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£11,402	6·76d.	£11,317	5·18d.	−1·58d.
Meter rents, &c...	130	·08d.	413	·19d.	+·11d.
Sale and repair of apparatus, &c.	50	·03d.	44	·02d.	−·01d.
Sundry rents received ..	120	·07d.	109	·05d.	−·02d.
Gross revenue ...	£11,702	6·94d.	£11,883	5·44d.	−1·50d.

Eliminating the cost of maintaining the public lamps, Mr. Andrews gives the total costs for 1899 and 1900 as 3·63d. and 3·51d. Including all items, the total cost now stands at 3⅜d., or over ½d. better than in 1899, in spite of a large increase in the price paid for coal and consequent rise of over ½d. in this item per unit alone. Part of the increase was attributable to the uneconomical conditions of the plant while run in a roofless station with building operations proceeding. The total cost now stands at the figure the works cost did in 1898. It may be noted that wages, repairs, rent, salaries and establishment charges have been reduced in the *gross*, a very remarkable achievement, which explains how an increase of over ½d. on the first item is changed to a fall of over ½d. by the time the total is reached.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal, and unloading same ..	£2,663	1·58d.	£4,624	**2·11d.**	+·53d.
Oil, waste, water and engine room stores	459	·27d.	497	**·23d.**	−·04d.
Salaries and wages incurred in generation and distribution	1,004	·60d.	980	**·45d.**	−·15d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and street lamps	628	·37d.	393	**·18d.**	−·19d.
	273	·16d.	206	**·09d.**	−·07d.
Works cost ...	£5,027	2·98d.	£6,700	**3·06d.**	+·08d.
Rent, rates and taxes ..	450	·27d.	406	**·19d.**	−·08d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	576	·34d.	569	**·26d.**	−·08d.
General establishment charges, stationery and printing, law charges and insurance	330	·19d.	312	**·14d.**	−·05d.
Other expenses	—	—	—	—	—
Total costs ...	£6,383	3·78d.	£7,987	**3·65d.**	−·13d.

The financial position is not quite so rosy as the engineering outlook. Revenue increased by £181, but expenses by £1,604; this brought down the gross profits by £1,423, from £5,319 to £3,896. Then the financial charges were augmented by £855, from £4,782 to £5,637. Thus, the latter increase, coupled with lessened gross profits, meant a reduction of £2,278 in the balance-sheet, which absorbed the net profit of £537 in 1898, and left a deficit of £1,741. Increase of output will improve this section of the accounts.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans	£2,446	£3,331
Sinking fund for repayments	2,336	2,306
Net profit carried forward	253	− 1,741
„ „ to expenses of order, &c. ..	284	—
Gross profit	£5,319	£3,896

CITY NOTES.

Electrical Power Distribution Company.

THE directors' report to be presented to the meeting to be held at Surrey House, Victoria Embankment, W.C., on Tuesday, June 4th, reads as follows:—

"The directors beg to submit their report and the statement of accounts, with the auditor's report thereon, from the formation of the company to March 31st, 1901. The profits amount to £15,001 2s. 9d. and, after deducting the proportion of general expenses chargeable to revenue, and the expenses incurred in connection with schemes not proceeded with and written off, and a sum of £1,271 5s. 9d. held in reserve in respect of new schemes in course of development, there remains a net profit of £13,045 11s. 2d., which the directors propose should be applied as follows:—

Preliminary expenses written off	£826	6 2
Reduction of furniture account	55	15 2
Payment of income-tax	513	17 8
Dividend at the rate of 5 per cent. per annum on ordinary shares for nine months or from the dates on which calls and instalments were paid	1,320	2 10
Carried forward to next account	10,329	9 4
	£13,045	11 2

"The company was incorporated on June 23rd, 1898, with a nominal capital of £20,200, divided into 2,000 ordinary shares of £10 each, and 200 deferred shares of £1 each, and by special resolution dated April 19th, 1900, the capital was increased to £300,000 by the creation of 12,980 ordinary shares of £10 each, and 15,000 preference shares of £10 each. The subscribed share capital is now:—£149,800 in ordinary shares of £10 each, £200 in deferred shares of £1 each, £150,000. There are at present unissued, 15,000 preference shares of £10 each, which the directors propose to issue at an early date on terms to be announced. The total amount expended on Electric Power Acts and negotiations in connection with new schemes in course of development, less amount reserved, was £16,840 13s. 6d., after writing off expenses incurred in respect of schemes not proceeded with, but including a portion of general expenses. The total expenditure under investments was £31,730 13s. 0d. The directors who retire this year are Mr. Emile Garcke and Mr. John S. Raworth, and both are eligible for re-election. Mr. Ernest Wright, A.C.A., retires, and his firm, Messrs. Wright & Wake, offer themselves for re-election." The following is a copy of the appendix attached to the report:—

The attention of the company has been particularly directed to economy in capital cost and administrative charges in connection with the electrical supply undertakings in which it is interested, and to developing the association with electrical traction and other allied interests, so as to secure a comprehensive demand, a cheap and reliable supply to the public and a satisfactory return upon the investment. The working agreement with the British Electric Traction Company, Limited, promises to be of much assistance in this direction, as it is enabling the electrical supply and the electrical traction undertakings in the same districts to be worked together to mutual advantage, and under the most favourable conditions in regard to operating expenses. The extent of country over which electrical energy can be the most cheaply distributed, and over which improved traffic facilities can be given by means of electrical traction, has largely increased during recent years. There are indications that comprehensive undertakings combining these services, will equal in importance some of the largest national industries, and that the arrangements most satisfactory to the public are as little susceptible of local treatment within arbitrary boundaries as are the railway or telegraph systems of the country. The business undertaken by this company in association with the British Electric Traction Company is directly in this line of development, and it is believed that the positions which the company has secured, will enable it to show satisfactory results from year to year while making those extensions which circumstances render desirable. The following are concise particulars of undertakings now in hand:—

Banbury.—The E. P. D. Co. has obtained the Banbury Electric Lighting Provisional Order intended to be transferred to the Banbury & District Electric Supply Company, Limited, which has been formed for the purpose of carrying out the undertaking. Present subscribed capital £25,000.

County of Durham.—The County of Durham Electric Power Distribution Company, Limited, has been formed with a capital at present subscribed of £30,070, for the purpose of carrying out electrical supply undertakings in that county. Provisional orders under the Electric Lighting Acts, authorising retail supply to consumers for power, light and other purposes have been obtained for Gateshead, Jarrow and Durham (City). Satisfactory progress has been made with the work, and it is expected that general supply will be commenced during the present year—

In Gateshead about August 1st.
„ Durham (City) about September.
„ Jarrow about November.

With a view to facilitating the operations of the above company, and those of the British Electric Traction Company, Limited, in the same area, the E.P.D. Co., in the last session of Parliament, obtained an electric power Act, under the title of the County of Durham Electric Power Supply Act, 1900, by means of which electrical energy can be supplied in bulk under favourable conditions to retail undertakings such as those above-mentioned, to electric tramways and light railways, and to other authorised users for prescribed purposes within an area of about 250 square miles, bordering on the south side of the river Tyne, and comprising a large portion of the engineering and colliery districts of the county. The construction of the main power station at Gateshead has kept pace with the equipment of the local sections of the traction scheme for the county to which it is supplying current, and both of these undertakings have been successfully inaugurated this month.

County of Kent.—The E.P.D. Co. has obtained the Sheerness Electric Lighting Provisional Order, 1900, and the Sevenoaks Electric Lighting Provisional Order, 1900, and it is intended to transfer these orders to the County of Kent Electrical Power Distribution Company, which has been formed with a capital at present subscribed of £25,000, for the purpose of carrying out such undertakings in the County. The British Electric Traction Company, Limited, is promoting a light railway order for Sheerness, which has been passed by the Commissioners, and it is intended that this line, when authorised and equipped, shall be worked in conjunction with the electric supply undertaking.

County of Northampton.—The Wellingborough Electric Lighting Provisional Order has been obtained by the E.P.D. Company, and it is intended to transfer it to the County of Northampton Electric Power and Traction Company, Limited, which has been formed with a capital at present subscribed of £25,000 to carry out this and other electrical undertakings in the county. The British Electric Traction, Limited, has obtained an Act authorising the construction of an electric tramroad system in Wellingborough, Rushden, and neighbouring districts, and with a view to economy in administration it is in contemplation to work the undertakings conjointly.

County of Surrey.—The County of Surrey Electrical Power Distribution Company, Limited, has been formed, with a capital at present subscribed of £25,070, and provisional orders under the Electric Lighting Acts have been obtained for the neighbouring districts of Sutton, Carshalton, and Wallington. It is expected that the supply will be commenced during the present year.

County of Sussex.—The provisional order under the Electric Lighting Acts for the Borough of Lewes has been obtained for the County of Sussex Electrical Power Distribution Company, Limited, which has at present a subscribed capital of £20,070. The works are on the point of completion, and supply will commence next month.

North Metropolitan District.—The North Metropolitan Electrical Power Distribution Company, Limited, has been formed, with a capital at present subscribed of £25,070, for the purpose of carrying out electrical supply undertakings in this important district. Provisional orders under the Electric Lighting Acts authorising retail supply have been obtained for Barnet and

Registered office, 20, Regent Street, Cambridge.

Average price per unit sold	...	6·76d.	5·18d.	−1·58d.

Hertford, and negotiations are proceeding with other districts. In Barnet the supply was commenced in September of last year. In Hertford the undertaking is well advanced, and the supply will be ready for the autumn of the present year. With a view to the supply of electrical energy in the North Metropolitan districts under comprehensive and economical conditions, the E.P.D. Co., in the last session of Parliament, applied for and was granted the North Metropolitan Electric Power Supply Act, 1900, authorising the supply of electrical energy, under conditions similar to those of the County of Durham Act, within an area of about 825 square miles, including the great suburbs to the north of London, from Tottenham on the east to Harrow on the west, and the growing manufacturing districts along the river Lea. It covers the area within which the extensive North Metropolitan electrical light railways are being promoted by the British Electric Traction Company, Limited, and allied interests.

Penarth.—The Penarth Electric Lighting Company, Limited, with a present subscribed capital of £25,000, has the provisional order under the Electric Lighting Acts for Penarth, a growing residential district and seaside resort adjoining Cardiff. The works are in course of construction, and the supply is expected to commence in the coming month.

Staines, Egham and Chertsey.—The E.P.D. Company has obtained a provisional order under the Electric Lighting Acts, for the neighbouring districts of Staines, Egham and Chertsey, and it is intended to transfer it to the Thames Valley Electric Supply Company, Limited, which has been formed with a capital at present subscribed of £25,000 to carry out the undertaking.

Weston-super-Mare.—A provisional order under the Electric Lighting Acts has been obtained by the Weston-super-Mare and District Supply Company, Limited, which was formed for the purpose of carrying out the undertaking, and has a capital at present subscribed of £25,070. The works are now on the point of completion and supply will be commenced immediately.

In addition to the concession for the electrical supply, the company has also obtained a provisional order for a system of electric tramways in the town, and with a view to producing the most satisfactory results, it is intended that the two undertakings shall be worked together.

West India and Panama Telegraph Company.

The 48th ordinary general meeting of shareholders of this company was held on the 23rd inst., at Winchester House, Old Broad Street, Mr. W. S. Andrews, the chairman, presiding.

The Chairman, in proposing the adoption of the report, said the receipts from subsidies and messages for the half-year had amounted to £24,300, as compared with £22,643 for the corresponding period, showing an increase of £1,656. The expenses had amounted to £20,962 as against £21,432, a decrease of £469. As regarded ships and repairs, the expenditure had been £8,121 for the last half-year, compared with £8,426 in the corresponding half. There was, therefore, a very inadequate increase in the receipts, and a small decrease in the expenses. In the number of words transmitted there had been a small increase in the International words, and a diminution in the Colonial words. That was in the number of words exchanged between the colonies themselves. The total result of it all was that there was an increase for the half-year of 7,000 words only, notwithstanding that they had still kept to the reduced charges. There was a balance on the year's working of £3,337, and to that had to be added £2,379 from interest on investments, which, with the £953 brought into the accounts, made a total of only £6,670. That sum was not sufficient to meet the cumulative dividends. The Court of Appeal had given judgment against the company in the case brought against them by the Cuba Company, and having regard to the fact that the judgments of both Courts were against them, the directors had thought it prudent to make provision for a possible final decision against the company, and therefore had decided to carry the balance of £6,670 to the next account. It was not much comfort, but still he might mention that that was not the first occasion on which the company had had to forego the payment on the first preference stock. It occurred in 1880 and in the following year, and in December, 1884, it was in arrear to the large amount of £65,851. Notwithstanding, by December, 1898, the arrears were all covered, and in 1891 there was a small dividend for the first time on the ordinary shares, which was then continued for every half year, with one exception, down to December, 1898. The dividends upon all classes of shares had to be made up from the appreciation of the reserve fund for the year 1899, and for the first half of 1901. That appreciation was now exhausted, and therefore they could not pay the preference dividend without trenching upon the reserve fund, which they were most anxious not to do. He was sorry to say that they had been very disappointed in the traffic receipts at Porto Rico. They had expected that with the occupation of the place by the United States they would have seen a very large increase, but unfortunately that had not taken place. The condition of our own colonies continued to be deplorable, and there was no doubt it was due to the practical failure of the sugar industry there; unless some remedy was speedily found, he was afraid the sugar industry in the West Indies would be extinguished completely, and that would be a most disastrous thing for the Island. In his mind mere palliatives, such as the substitution of other products, and so on, would never suffice to provide a permanent remedy. Sugar was the staple product of the West Indies, and nothing but the resuscitation of that great industry would permanently benefit the Island. That company was dependent upon the West Indies' prosperity, and unless something could be done to produce that, he did not see what they were going to do at present. They would be giving evidence before the Cables Committee next month, and if they could get any encouragement from the Government or from that Committee in the direction of a substitute, they would be glad to go on working at the reduced rates to see what could be done to improve the position.

Mr. Henry Holmes seconded the resolution.

In reply to several questions, the Chairman said that, of course, the directors were thoroughly alive to the disabilities under which the company were in connection with the agreement with the Cuba Company, and, of course, that company could see for themselves the present state of the finances of the West India and Panama Telegraph Company.

The report was then adopted.

The Bastian Meter Company.

We are informed that the fourth ordinary general meeting of this company was held at the offices, Kentish Town, on Thursday last week, under the presidency of Mr. C. O. Bastian, who, in moving the adoption of the report and accounts, congratulated the shareholders upon the fact that the company had obtained the certificate of the Board of Trade, which would improve the condition of their affairs very much, and enable them to tender where they had been previously prohibited, owing to specifications requiring that the meters should be approved by the Board of Trade. For instance, the other day they had a War Office specification which required that the meter should be approved by the Board of Trade. A great advantage of this certificate was that it put it out of the power of town councillors and consulting engineers to raise arbitrary objections to the use of their meter. The company made the cheapest electrical meter in the market, and in a short time he believed that they would find that ratepayers would be insisting on the town councillors accepting tenders which would mean a considerable saving in the initial outlay of an electrical installation. The company had considerably reduced the cost of manufacture, and they would soon be able to lower the selling price, and thus induce people to buy meters who had not done so before. He then gave details of the growth in their turnover and profits during the period of their existence, and expressed himself confident as to their future. He moved the adoption of the report and accounts, which was seconded by Mr. Ciantar and carried unanimously without discussion. The retiring director, Mr. Umberto Ciantar, was re-elected, as were also the auditors, Messrs. Percy Mason & Co.

A meeting of the preference shareholders was subsequently held, at which the following resolution was passed:—

That this meeting of holders of preference shares in the Bastian Meter Company, Limited, hereby consents to the issue by the company of debenture bonds to the extent of £6,000, bearing interest at the rate of 6% per annum. Such bonds being a first charge upon the assets and undertaking of the company.

Telegraph Manufacturing Company.

The directors' report, to be submitted to the meeting to be held at Liverpool on Friday, June 7th, reads as follows:—

The directors beg to submit to the shareholders their third annual report, accompanied by balance sheet and profit and loss account, for the year ending March 31st, 1901. The profit on the year's working, as shown by the profit and loss account, is £35,183 2s., and, adding the amount brought forward from last year, £5,825 8s. 9d., there is the sum of £41,008 10s. 9d. From this sum the managing director's salary (including a special grant to him of £1,000), and the directors' fees, amounting in all to £2,400; the duties in connection with the issue of the new ordinary shares, £255 5s.; the preference dividend for the year, £4,749 19s. 10d., and the interim dividend paid in December, 1900, £3,000, have to be deducted, and after placing to depreciation account the sum of £4,442, and to reserve fund £6,500, there remains a balance of £17,661 5s. 11d., which the directors recommend shall be dealt with as follows:—In payment of a further dividend at the rate of 12 per cent. per annum for the half-year (6s. per share), and a bonus of 2 per cent. (2s. per share), both free of income-tax, being in all at the rate of 12 per cent. for the year, and that the balance, £7,661 5s. 11d., be carried forward. The directors have the pleasure to state that the new issue of ordinary shares was fully taken up by the shareholders, and the premium on the same, amounting to £20,000, has been placed to the reserve fund; in addition to this, the directors have transferred to that fund the special insurance fund of £1,000, which was formed against claims which might arise under the Workmen's Compensation Act, as they have now been able to make satisfactory arrangements with a good company for the insurance of their workpeople. During the past 12 months the business of the company has been carried on under difficulties arising out of the extension of the Helsby factory and the erection of additional machinery, but the directors are pleased to be able to state that this work is now practically complete. The directors are fully convinced that the telephone industry will, in the near future, become a most important branch of the business, and in view of the fact that the Liverpool factory is being worked to its utmost capacity, they are taking the necessary steps to meet the increasing demand for telephone apparatus. The auditors, Messrs. Harmood Banner & Son, retire, and offer themselves for re-election.

Mix & Genest, Ltd., of Berlin.

The twelfth annual meeting of shareholders was held on May 18th at the Board Room of the above company, when a most satisfactory balance sheet was submitted. The gross profit amounted to £55,400, of which £17,750 are absorbed by income-tax, salaries and general expenses, and £11,700 are written off for depreciation on plant, tools, patents and premises, thus leaving a net profit of £25,950, out of which a 14 per cent. dividend has been paid to the shareholders. In the report of the board of directors, the continued progressive movement in the development of the concern is emphasised, especially the fact that during the last year the contracts placed by the Government Telephone Department with the firm, for multiple switchboards and telephone instruments, have been of considerable magnitude. All departments have not only been fully occupied, but in a good many instances overtime had to be worked to cope with the increasing orders. No less than 1,700 hands are at present employed, and although the new factory has only been built within the last four years, additional land had to be acquired in order to allow of further extensions, which, when completed, will cover an area of nearly 10,000 square metres. The prospects for the present year are considered to be highly promising, as evidenced by the considerably increased turnover as compared with the corresponding months of the previous year.

Drake & Gorham, Limited.

We learn that the well-known business of Messrs. Drake and Gorham, which was founded in 1886, has been formed into a limited liability company, a course which is becoming pretty general among large electrical concerns. The directors are Mr. R. Percy Sellon, Mr. J. C. Forster, a Hampshire county magistrate, Mr. Bernard Drake, and Mr. J. M. Gorham. In

the absence of details regarding capital, profits, and the price at which the shares are to be offered to the public it is not possible to be very precise in estimating the future prospects of the undertaking. We should think, however, that with so thoroughly well established and widespread a business as that of Messrs Drake & Gorham, there should be no apprehension as to the opportunities for earning good profits. Country house and other installations, also the manufacture and sale of the thousand and one things required for electric lighting and electrical engineering have been the firm's special business for years past, and these are branches in which there will be a great deal to do for many more years to come. Everyone knows how promising is the outlook for electric driving, especially in view of the large power schemes which are now attracting so much attention.

Electric Lighting and Traction of Australia.

An extraordinary general meeting of the above company was held at the offices, 123, Cannon Street, on Wednesday, Mr. J. B. Braithwaite (chairman) presiding. The meeting was of purely a formal character, being merely for the purpose of altering the articles of association to bring them into uniformity with the New Companies' Act. The necessary resolutions were carried.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to Ruston, Proctor & Co., Limited—further issue of 10,000 shares of £10 each, fully paid, Nos. 25,001 to 35,000; (2) to appoint a special settling day in British Electric Traction Company, Limited — further issue of 30,000 6 per cent. cumulative preference shares of £10 each, £6 paid, Nos. 160,001 to 190,000; and West London and Provincial Electric Supply Company, Limited—9,391 ordinary shares of £1 each, fully paid, Nos. 7,501 to 11,425, 12,926 to 15,025, and 16,026 to 19,391, and 33,814 6 per cent cumulative preference shares of £1 each, fully paid; and (3) to allow the following securities to be quoted in the Official List:—Edmundson's Electricity Corporation, Limited—6,637 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 1 to 6,637; Primitiva Gas and Electric Lighting Company of Buenos Ayres, Limited—£400,000 4 per cent. first debentures; Regent's Canal and Dock Company—further issue of £130 9 8 3 per cent. debenture stock. The committee has ordered the undermentioned to be quoted in the Official List:—Aron Electricity Meter, Ltd.—125,000 ordinary shares of £1 each, fully paid, Nos. 1 to 125,000.

Mexico Electric Tramways, Limited. — The fourth ordinary general meeting will be held at Winchester House on Wednesday, June 5th, 1901, at 12 noon.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending May 24th were £515; corresponding week last year, £507; increase, £8. Total to date, £9,367; corresponding period last year, £8,395; increase, £972. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending May 25th were £432; corresponding week last year, £414; increase, £18. Total to date, £5,131; corresponding period last year, £5,524; decrease, £393.

Bristol Tramways and Carriage Company.—The receipts for the week ending May 24th were £4,681; corresponding period last year, £3,169; increase, £1,512.

Central London Railway.—The receipts for the week ending May 25th were £6,165; previous week, £6,398; decrease, £233. Total receipts to date (21 weeks), £130,100. Miles open, 6.

City and South London Railway.—The receipts for the week ending May 26 h were £1,834; corresponding week last year, £1,355; increase (Moorgate extension open) £483. Total to date, £41,471; corresponding period last year, £26,320; increase, £15,151. Miles open, 1901, 4¾; 1900, 3¾.

Dublin United Tramways Company.—The receipts for the week ending May 24th were as follows:—D. U. T. Co., electric cars, £3,453 5s. 8d.; D. S. D. Co., electric cars, £966 12s. 3d.; total £4,819 17s. 11d.; corresponding week last year—D. U. T. Co., electric cars, £3,494 18s. 9d.; ditto, horse cars, £55 9s. 10d.: D. S. D. Co., electric cars, £823 9s. 5d.; total, £4,373 13s.; increase, £446 4s. 11d.; aggregate to date, £83,358 15s. 11d.; aggregate to date last year, £84,096 16s. 9d.; decrease, £738 0s. 10d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending May 26 h were £1,565; corresponding week last year, £1,429; increase, £136. Total to date, £32,376; corresponding period last year, £29,657; increase, £2,719. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The Electrical markets of the Stock Exchange are enjoying a fair amount of business, holidays considered, and there is a steady demand for the best class shares. This is more particularly the case in the Supply Companies' section, where a movement originated last week for buying up the pre-Ordinary shares of the most popular undertakings. The firmness this brought about has now extended to the Ordinary shares, and buying orders in St. James's, Metropolitans and Westminsters are quietly relieving the market of its floating supply. More noticeable, however, as regards quotations, is the improvement that is taking place in National Telephone descriptions, upon the report that a working agreement has been arranged between the company and the Government. The telegraph department is inanimate, and the few recordable changes do not amount to very much.

In the Home Railway market Waterloo and City stock has shed a point, after standing at 95½ for weeks past. As the return to an investor is only about three guineas per cent., at the present price, it will have to recede further before the stock holds out much temptation to a buyer. City and South London Ordinary shares are a fraction easier, and now stand at a level 50 per cent. discount. Central Londons remain at their last week's price. It is rather amusing to see a fall in Lancashire and Yorkshire Railway stock, brought about by anticipatory alarms as to the way in which the company will be damaged by the new Express Electric Railway, which is to form another link between Manchester and Liverpool.

In the traction division, new "Potteries" are quoted at ¼ to 1 premium for the Ordinary, while the premium on the new Preference has subsided. The prices of the existing Ordinary and Preference are 11½ and 10½ respectively. British Electrics do not move. Brisbane Electric Tramways 4½ per cent. Debenture stock is being dealt in at 100. Electric Lighting and Traction of Australia 6 per cent. Preference shares have advanced during the week, and now stand at 5, their par value. It is thought that the celebrations in connection with the opening of the Federal Parliament should largely benefit this company.

The firmness of Electricity Supply shares finds but little visible illustration in the price list. But, as we have said, the demand for the best shares is making itself felt. Edmundson's are a good market, and we do not think we are divulging State secrets by heralding the approach of a new concern from this promising quarter. Will it, we wonder, be called the Urban Electric? Interest is growing in the less-known shares dealt in by this market, but quotations do not at present respond. Blackheath Ordinary are 10s., Bournemouth and Poole 12, Calcutta 7½ *ex* dividend, and Hove Electric 8. Folkestone Ordinary keep steadily at 5½, and Oxfords are 6 middle. But the greatest interest of all is centred upon Metropolitans, which, with St. James's, are 10s. harder on the week.

It is now thought the Metropolitan Company may possibly discover that one-third of its undertaking will vanish when the Marylebone slice is handed over finally to the local authorities. Discussion is loud as to how the money obtained by the sale of this portion ought to be applied. Some favour the suggestion we made a fortnight since, and hope that the Debenture debt will be wiped out, or at least largely reduced. Another proposal is that so much per share should be returned to proprietors, lowering the present £10 denomination. Others again are advocating the establishment of a separate and enormous reserve fund. Whatever the Board may decide to do, it is hardly likely to adopt the wasteful theory embodied in the last suggestion.

Painstaking efforts are being made in order to introduce more publicly the Marconi Wireless Telegraphy shares. The price is still in the neighbourhood of 3⅜, and its stubborn refusal to move must be disappointing to those who have got the shares. The telegraph market, as a whole, is comparatively changeless. Submarine Cables Trust certificates are up four points, but this is virtually a recovery of ground lost last week. Amazon Debentures still soar, and are up to nearly 75. Earlier in the year, it may be remarked, they were nominally 85. By rising 1 per cent., Western Telegraph 5 per cent. Debentures came into line with the 4 per cent. Debenture stock. Both are now 103½. The Anglo-American and the Far Eastern groups are equally featureless. West India and Panama shares show incipient signs of convalescence after their heavy slump, brought on by the dividends passing, but quotably the prices are unaltered.

For the sensation of the week the telephone market must be awarded the palm. Nationals rose to nearly 4, and although barely maintaining their best level, are still ¼ up on the week—a most remarkable jump for them. The rumour of the Government coming to an amicable agreement with the company is considered as almost too good to be true, but, after all, it would be a very common-sensible way out of a grave difficulty, and there is no reason why businesslike negotiations should not be opened. Under these most hopeful circumstances, we would venture to think that National Telephone 4 per cent. Debenture at 3 points below par is distinctly cheap, while the 3½ per cent. Debenture at 89 falls into the same category.

The manufacturing brigade is chiefly noticeable for a rise in British Westinghouse Preference, a result of the coming new issue, which in the present case has acted as a stimulus to the market rather than otherwise. No market has been made in Thornycroft Preference up to the time of writing.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations May 22nd.	Closing Quotation May 29th.	Business done during week ended May 29th, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	99 —102	100 —103	...	...
119,700*l*	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	55 — 65	73 — 78	...	...
822,700*l*	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	53 — 56	53 — 56	...	...
3,088,540*l*	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99	97 — 99	98½	98
3,088,540*l*	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	10 — 10½	10 — 10½	10¼	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3¼ — 4	3½ — 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	...	...
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000*l*	Do. do. 4½ % Debs.	50	...	...	...	100 — 104%	100 —104%	...	...
60,710*l*	Direct United States Cable	20	3½%	3 %	3 %	10 — 10½	10 — 10½	...	...
108,300*l*	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	140 —145	140 —145	141	...
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	91 — 94	91 — 94	91⅞	91¼
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	110 —114	110 —114	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13½ — 14	13½ — 14	14	13 9/16
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) ...	10	...	...	...	13¼ — 14	13½ — 14xd	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000*l*	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	...	9½ — 10	9½ — 10	10	9¾
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜ — 15½xd	14⅜ — 15½	15½	15
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	32 — 34	32 — 34	...	...
82,000*l*	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	100	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	47 — 47 xd	43 — 47	43½	...
100,000*l*	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼ — ½	¼ — ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅜ — 1	⅜ — 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3⅜ — 3⅝	3⅜ — 4	3 15/16	3 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 12	11¼ — 12½	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	11½ — 12½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅛ — 4⅜	4⅜ — 4⅝	...	...
2,000,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	87 — 90	87 — 90	...	...
500,000*l*	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98	95 — 98	96¼	95
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞ — 1 xd	⅞ — 1	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½ — 8½	7½ — 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	121 —126	125 —130	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4½ — 5	4½ — 5	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅞ — 5¼	4⅞ — 5¼	...	...
179,947*l*	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	99½	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼ — ⅜	¼ — ⅜	...	...
150,000*l*	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	160 —103	100¼	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜ — 14¼	13⅜—14¼	13 13/16	13⅜
75,000*l*	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	102 —105	...	...
348,777*l*	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	8%	...	⅜ — ⅝	⅜ — ⅝	9/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	5 5/16	5
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞ — 8¼	7⅞ — 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½ — 9	8½ — 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼ — 5⅝	5¼ — 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	6 — 6½	6 — 6½	...	...
150,000*l*	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	111	110¾
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½ — 9½	8½ — 9½	8⅝	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
400,000*l*	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8 — 9	8 — 9 xd	8½	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	11½ — 12½	11½ — 12½	...	...
200,000*l*	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	105 —108	105 —108	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	5¼ — 5⅝	5¼ — 5⅝	5 9/16	5½
13,363	Do. do. 6 % Cum. Pref.	...	...	...	...	5½ — 6	5½ — 6	5 11/16	...
75,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	104 —107	104 —107	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 — 105	102 —105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½ — 1¾	1½ — 1¾	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000*l*	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13½ — 14½	14	13 7/16
220,000*l*	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	...	...
250,000*l*	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½ — 16½	15½ — 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ — 15½	15 — 16	15½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ — 9½	8½ — 9½	...	...
150,000*l*	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000*l*	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½ — 3½	2½ — 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12 — 13	12 — 13	12⅝	12½

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation May 22nd.	Closing Quotation May 29th.	Business done week ended May 29th, 1901. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7½— 8½	7½— 8½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	85 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	...	...	14½— 15½	14½— 15½	15	14⅝
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅝	12 5/16
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	122	121
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝— 1⅞	1⅝— 1⅞xd	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	104	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14½— 15	14½— 15½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅝	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9½— 10	9½— 10	9⅝	9½
78,703	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	4⅝	4 11/16
78,703	Do. do. Def. do.	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	51 — 53	51 — 53	51½	51
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	10	...	...	...	5 — 5⅛	4⅞— 5⅛	5	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½— 4	3½— 4	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —104	101 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1 — 1⅛	1 — 1⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	2½— 3½	2⅜— 3½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	87 — 89	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅜— 2⅛	1⅜— 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2⅛— 3	2⅛— 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½— 16½	15½— 16½	...	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5⅛— 6	5⅛— 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅜%	3½%	8 1/16— 8 3/16	8⅛ — 8¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	35 — 39	35 — 39	37¾	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½— 11½	10½— 11½	10½	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½— 6	5½— 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	94 — 97	93 — 96	95	94

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, 1/8—1/4.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (February 21st, 1901).

MARKET QUOTATIONS, Wednesday, May 29th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	99/-	99/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23	£23	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¼d.	8¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6 5s.	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots ..	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	7½d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
c ,, (Electrolytic) Bars ..	per ton	£82	£82	..
,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/9½ to 3/10½	3/9½ to 3/10½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	45/8	45/10	2d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10 5	£10 5	..
g Lead, English Ingot	per ton	£12 10 to £12 12 6	£12 10 to £12 12 6	..
g ,, ,, Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/8	3/3 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10¾d. to 1/0½	10¾d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£132 to £133	£130 to £131	£2 inc.
g ,, foil	per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/8	1d. inc.
p White Anti-friction Metals —				
"White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	6¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

GLASGOW INTERNATIONAL EXHIBITION.

The Engineering Exhibits.

(*Concluded from page* 910.)

The Machinery Hall.

Messrs. Tangyes, Limited, of Birmingham, are largely represented, their gas and steam engines and centrifugal and electrically-driven pumps and other machines being in evidence.

In the same neighbourhood we came upon the exhibit of the Anderston Foundry Company. We believe that the "Anderston" compound quick rotative enclosed engines are not so familiar to electrical engineers as they well might be. They are being employed in connection with a goodly number of electric power installations, particularly in that hive of engineering and shipbuilding industry, the Tyne district, and in engineering districts in certain parts of Scotland. The company is a very old established one, but the manufacture of the "Anderston" engine is a matter dating back only a few years. The engine exhibited at Glasgow is one of the company's latest specialities, being a 260-I.H.P. quick revolution, compound, double-acting engine, coupled direct to generator. The engine is completely enclosed, having the entire main bearings inside casing. The main casing is very roomy, and fitted with four large hinged doors, rendering it as accessible as any open engine, thus getting over any objection that may be advanced under this head to the enclosed type; it is claimed to be self-lubricating, cleanly and economical, and very compact; also to have no impediments in front openings in casing. Several thousand horse-power of the engines are now on order and in progress, and over 4,000 H.P. at work in various parts of the country. Mr. Fraser is in attendance here.

Messrs. D. Selby Bigge & Co. are exhibiting jointly with the Anderston Company, and they show a combined engine and continuous current generator, a shipyard winch, and various electrically-driven tools, including a model punch and shear and motor.

Worthington pumps are shown in operation by the Worthington Pumping Engine Company, of London, feed-water filters and other steam engineering specialties by Messrs. Railton & Campbell, of Liverpool, also steam pumps, grease filters, valves, &c., by Messrs. J. H. Carruthers & Co., of Polmadie.

Messrs. Richardsons, Westgarth & Co., Limited, have an exhibit at which they show a 500-I.H.P. steam-driven dynamo, electric motors, Edwards's air pumps (electrically driven) also feed heaters, evaporators and other steam plant. A 200-KW. three-phase alternator (5,000 volts) made by the Lancashire Dynamo Company, is shown coupled to a Hick-Hargreaves vertical compound enclosed engine at Messrs. Hick, Hargreaves & Co.'s stand. This machine will develop three-phase current at 5,000 volts across the outers at a periodicity of 50 per second. The Lancashire Company are supplying some 100 KW. continuous current to the Exhibition authorities through one of their motor alternators.

At the end of the Machinery Hall, adjacent to the power station, is the exhibit of Messrs. Alley & MacLellan, who are showing a large variety of their specialities. In the centre of the exhibit is a stand with a representative display of steam, water and gas valves and fittings. On view also are ash hoists representing both Admiralty and merchant service styles, "Boreas" patent steam and belt-driven air compressors, the "Sentinel" patent feed water filter, and "Binny's" patent feed water heating apparatus. The feature likely to attract most general interest is the display of high-speed engines. These are the well-known "Sentinel" single-acting type, both simple and compound. There are two very compact marine auxiliary engines, one of 5 B.H.P. shown working a centrifugal pump raising water, and the other 10 B.H.P. coupled to a Laurence-Scott dynamo for the lighting of the exhibit. Engines of a higher power for generating sets are also on the stand, one of 50 B.H.P. with dynamo attached, and the other of 180 B.H.P., and all exhibits where possible are shown under steam. Close by in the main power station Messrs. Alley & MacLellan have a 300-B.H.P. engine and dynamo working.

A three-throw pump, made by Messrs. Joseph Evans & Sons, of Wolverhampton, is shown by Messrs. Hunter & Jack, of Glasgow, the agents for the Electric Construction Company, who are exhibiting this pump, combined with an E.C.C. motor. Other E.C.C. motors, of E.C.C. manufacture, are also shown. Messrs. W. H. Willcox & Co. have a showcase of their engine and dynamo oils, also pumps and other specialities. Taylor's patent metallic packing is shown by Messrs. Newton and Nicholson, of South Shields.

Messrs. Daniel Adamson & Co., of Dukinfield, place on view one of their high speed horizontal engines driving by belt a continuous current generator, and a tandem compound with direct-driven generator. The Diesel oil engine, which has recently been described in the ELECTRICAL REVIEW, is exhibited by the Diesel Oil Engine Company, of London, a 15-B.H.P. size being shown. An electric lift with patent automatic stopping devices, also pulley blocks, &c., are shown by Pickerings, Limited. Friction clutches for motor vehicles are to be seen at the stand of the Champion Friction Clutch Company, of Sheffield. Messrs. Croft & Perkins, of Bradford, exhibit friction clutches, also split pulleys, gearing, shafting, &c. Messrs. Leadbeater & Scott, of Sheffield, exhibit their crucible cast-steel for tool purposes.

Perhaps the largest individual exhibit of electrical and engineering machinery is that of Messrs. Mather & Platt, Limited. It covers a good deal of space, and may be taken as a representative show of the first-class manufactures of the Salford firm. Electric generators, motors, pumping machinery, water-softening, textile machinery, and various other special lines, are well shown. We hope to refer to the exhibit in detail at a later date.

In this portion of the Machinery Hall the visitor will come across various exhibits of a general kind, such, for instance, as a bakery and confectionery stand, where electric motors are doing interesting work.

Machine Tools.

As we have already stated, there is a very large and excellent collection of machine tools, both of British and foreign manufacture, and anyone who wants to get at the ins and outs of the question of foreign competition in this class of engineering industry would find it well worth while to make a call at each of these exhibits and have a chat with the responsible representatives who are in attendance. We must, at the moment, be content with a mention of the exhibits in the briefest outline.

Mr. Henry Milnes, of Bradford, shows various kinds of lathes. Messrs. John Lang & Sons, of Johnstone, have their patent lathes, gear-cutting and universal cutter and sharpening machines. The Jones & Lamson Machine Company, of America, show flat turret lathes, grinding and sharpening tools. Messrs. Clifton & Waddell, of Johnstone, exhibit saw-sharpening and band and circular sawing machines. Drilling, boring, turning and milling machines, cold saws, lathes, &c., are shown by Messrs. John Hetherington & Sons, Limited. Labour-saving machines, including patent lathes, and screw-milling machines are shown by Messrs. John Holroyd & Co., of Manchester. Messrs. Kendall & Gent, of the same city, have an extensive showing of milling machines (vertical and horizontal), also screwing and drilling machines and lathes. Moulding machines for foundry service, pneumatic-power hammers and blowers are placed on view by Messrs. Samuelson & Co., of Banbury. Vertical millers, key-seating machines, sad planing machines, and a 5 ft. radial drill are among a variety of excellent machines exhibited by Messrs. Smith & Coventry, Limited. One 1-H.P. and two 2-H.P. Crompton electric motors are installed for driving these tools.

The machines shown by Messrs. Selig, Sonnenthal & Co. are very numerous. A 15-H.P. motor is used for driving the stand. The exhibits include the multi-speed motor made by the Stow Co. in connection with the Stow flexible shafts and drilling plants. The drilling, planing and universal milling machines; Becker millers with rotary attachment and pump; the Newark motor horizontal boring machines with new treble-geared drive; the Lodge and Shipley screw-cutting lathes for 12 in. and 8 in. centres, with 12 ft. and 6 ft. beds; the Dresses-Mueller 36 in. and 48 in. radial drilling machines arranged for tapping; brass finisher's lathes; new tool threaders; automatic screwing and threading machines; the Hamilton vertical drills, 24 in., 28 in. and 32 in.; the Toledo open back power presses; the Quint four-spindle turret drills; the Gorton universal disc grinders, both belt and motor driven—these are a few of the things shown in the Machinery Hall exhibit of Selig-Sonnenthal.

Messrs. Sharp, Stewart & Co., of Glasgow, have a good showing of machines all driven by belt from an electrically-driven shaft. Planing machines with patent feed, horizontal boring, drilling and screw-cutting machines; triple-geared lathes; slotting machines, &c., being in evidence.

Messrs. Hulse & Co., Limited, whose great feature is heavy tools, claim that in their class of work the British manufacturer is well able to hold his own against the foreign competitor. The firm have supplied various machines, such as double-boring and milling machines, for English electrical factories, among them being the works of Messrs. Belliss & Morcom and Easton & Co. Their cutter-grinding machines with new form of cutter with conical-faced edge; the patent intermittent printing machine, which is worked by magnets which draw the rollers away, is a patent of Messrs. Hulse's, and is on view; double-rail planing and shaping machines; double patent twin-screw lathes largely used by steel makers—these are the firm's special features.

Messrs. Burton, Griffiths & Co., of Ludgate Square, E.C., show both American and English machines. The Gisholt universal tool grinder is driven by a 5-H.P. Northern Electrical Company's motor, and the principal shaft on the stand is driven by a 20-H.P. motor by the Lancashire Dynamo Company. The Landis tool grinder is specially adapted for grinding electric motor shafts, and has been supplied to English firms for that purpose. Gisholt lathes, multiple spindle screw machines, boring and turning machines, forging, threading, tapping and milling machinery are shown at this stand.

The exhibit of Messrs. Buck & Hickman, of Whitechapel, consists of the most modern exhibit of tools from the firms of Messrs. Brown and Sharpe, Providence, R.I., the Pratt & Whitney Company, Hartford, Conn., the Bradley Company, Syracuse, N.Y., and the Williams Drop Forge Company, Brooklyn, N.Y., and several other American firms. Messrs. Buck & Hickman's staff is represented by Mr. Frank Cooper, and anyone who makes a call at the stand will be cordially received.

Messrs. R. Melhuish & Sons have an exhibit of stocks and dies, and a representative show of small electrical supplies. Engineers' tools and light machinery of the latest labour-saving designs for particular classes of work are on show here. Messrs. Loudon Bros., of Johnstone, show various lathes, planers, drills, injectors, steam traps, &c. Guards for planing and moulding machines, also wood working tools, &c., are shown by Messrs. W. Cook & Sons, of Sheffield.

Messrs. Alfred Herbert, Limited, have one of the largest and most commanding shows of machine tools in the Hall. A 30-H.P. Mavor & Coulson motor drives the shaft which operates a large variety of automatic and other machinery suitable for electrical engineering and other purposes. Their turret and capstan lathes, milling machines, also automatic screwing machines are arranged in a very convenient manner for inspection.

MISCELLANEOUS.

In the Industrial Hall, in a prominent position, Messrs. Osler and Co. have a very fine stand at which their electric and other glassware and fittings are well set out. The Electrical Power Storage Company has a good showing of its well-known batteries, including an electric victoria fitted with Faure-King cells. In the lighting and heating section we came across an stand of the Cape Asbestos Company at which they show their pure asbestos mattress and rope for covering boilers and steam pipes, also their blue asbestos removable coverings.

Several exhibits of electrical apparatus are to be found in the industrial section. These include a showing of telegraph and telephone apparatus by the Consolidated Telephone Construction and Manufacturing Company. Messrs. Kelvin & James White, Limited, have on view a variety of their electrical and submarine telegraph and other instruments. Mr. James Brown, of Glasgow, shows various electrical measuring instruments, resistance boxes, bridges, &c. Messrs. James Baird & Tatlock show various apparatus for laboratory equipments, including galvanometers and electrical instruments. The Eastern Telegraph Company shows, near at hand, a model cable ship and submarine telegraph apparatus. Messrs. Stern Bros. show their oils and lubricants for electrical and ordinary machinery, also automatic lubricators and grease pumps for forcing the lubricant from one point into the various engine bearings.

The two electric lifts which are used for the conveyance of visitors up to the Exhibition balconies were supplied as a complimentary exhibit by Messrs. Easton & Co., Limited. The Zurich Incandescence Lamp Company has supplied the Stearn lamps of 250 volts for lighting the Industrial Hall, and also one of the kiosks and several of the restaurants in the grounds.

The new Art Gallery, which will be, and deservedly so, a source of great attraction both during the run of the Exhibition and after, is well lighted by electricity. The wiring is done on the system of the Conduit and Insulation Company, Limited, with enamelled steel tube material, of which many thousands of feet have been employed. Various new and special devices had to be put in to meet the required conditions.

We have now briefly run over all the exhibits connected with the electrical and engineering industries. It is, of course, understood that a general introductory article of this character can only indicate roughly the class of exhibits which are in evidence. It may be open to the charge of being a good deal like a catalogue, but we venture to believe that in the early stages of a great exhibition, it is just the sort of thing the engineering visitor is in need of. If, perchance, some exhibit which should have been mentioned happened to be overlooked, we shall be glad to receive particulars, so that we may do the needful.

IMPORTANT EUROPEAN ELECTRICAL AND ENGINEERING DEVELOPMENTS.*

BY WILLIAM J. HAMMER.

(*Continued from page* 905.)

ALL of the lamps which I saw in Europe were run on a 200 to 220-volt circuit, excepting a few I saw in London on 100-volt circuits, and as a rule 25-C.P. lamps were used.

In the large types of lamps it was found that the magnet coil was frequently burned out from over-heating, and to obviate this the shell of the socket was perforated, which, however, exposes the connections to some risks of short circuits, and the present form will doubtless soon be altered.

The fine iron wire connected in series with the filament, which has been considerably utilised in the past, has usually been about ·019 mm. in diameter. This iron wire, or the platinum wire, which has so extensively taken its place, is used because of the glower lowering its resistance so rapidly when the temperature increases. A very slight variation in the voltage increases very much the candle-power of the filament and the strains upon it. The wire is so proportioned that with about a normal current it is heated to a range of temperature of about 450 to 500° C., at which iron has a very rapidly rising temperature characteristic—that is, its resistance increases very rapidly with an increase of temperature caused by an increase of current. Being in series with the filament, the total resistance, which determines the amount of current supplied to the lamp, will be the sum of the glower and of the iron steadying wire, and as one decreases with increase of temperature, the other increases and compensates for it, keeping the sum approximately constant. The iron resistance absorbs about 10 per cent. of the voltage. As pointed out by Prof. Nernst and Dr. Spies, according to the law of Kirchoff, all opaque bodies emit more calorific than luminous rays, furnishing what is termed the normal spectrum of an opaque body, but according to the well-established electro-magnetic theory of light, all conductors of electricity are of necessity opaque to luminous radiations. It is to be expected, therefore, that as long as electrical conducting materials are used as light-emitting substances in lamps, the bulk of the energy expended upon them will be wasted in thermal radiations, and only a small portion will be transformed into luminous radiations. It is impossible to make an efficient lamp with such materials except under the conditions of working at the temperature of the electric arc.

At the Paris Exposition the A.E.G. made an interesting exhibit of the Nernst lamp, and advertised that it had an efficiency of 1·6 watts per candle-power, a life of 200 to 300 hours, an E.M.F. of 220 volts and from 26 to 50 C.P. Mr. James Swinburne, in his lecture before the Society of Arts, February 8th, 1899, stated the watts per candle for small lamps, including the steadying resistance, as 1·5, and for large lamps as 1·6. At present the London company, with which he is connected, state that their Nernst lamp has an efficiency of 1·7, including the resistance in series with the filament.

There is undoubtedly a large field for the application of lamps of the Nernst type between the field occupied by the 16 to 50-C.P. incandescent lamps and the arc lamp, and it lends itself to decorative effects equally well with the incandescent lamp. The candle-power of arc lamps is something that has never been satisfactorily determined, and it has not infrequently been the custom in judging the candle-power of arc lamps to "guess at it and multiply by four." In candle-power steadiness, colour of light and ability to throw the light down where it is needed and in requiring less attention, the Nernst lamp will doubtless prove superior to the arc lamp. There will be little difficulty in making lamps of the Nernst type of very high candle-power by employing longer filaments, or preferably a number of filaments in series or multiple series, and potentials of 500 to 1,000 volts may thus be employed. Promising as the Nernst lamp undoubtedly is, it will probably, by reason of the difficulties in the manufacture of the lamp, be a long time before the carbon lamp is entirely displaced, if it ever is.

Dr. Otto F. Blathy, director of Ganz & Co., Buda-Pesth, Hungary, who, together with Eggers & Co., control the Nernst patents for Austria and Hungary, told the writer recently in Buda-Pesth, that when the Nernst lamp became a commercial article there would be no more arc lighting. He said that tests made by them showed that for a given number of watts the efficiency of the Nernst lamp was greater than that of the arc lamp, presumably meaning the spherical candle-power. Mr. James Swinburne in his lecture said: "Once the 'Nernst' becomes so general that systems of distribution are laid out to suit it, instead of to suit the carbon lamp, the carbon lamp is 'practically out of the running.'"

In this connection it will be remembered that with the advent of the Edison carbon filament incandescent lamp, it was believed that gas as an illuminating agent was doomed, whereas it has been shown that the incandescent lamp exercised a stimulating and beneficial influence upon the gas light, which is more extensively employed to-day than ever. The tendency of all great inventions is rather in the line of building up than tearing down.

It is impossible to operate the Nernst lamp in a vacuum, at all events where a direct current is employed, as being an electrolytic lamp, it is said to be necessary to admit oxygen to re-oxidise the magnesium liberated at the cathode. Where continuous currents are used in electrolytic lamps of the Nernst type, the liberation of ions at the connections produces a serious difficulty. I heard it claimed by some while abroad that the lamp operated more satisfactorily with a continuous current. Others, however, were positive that an alternating current was preferable. One prominent engineering authority went so far as to state to me that he did not believe that the lamp would be a commercial success, except when operated from a storage battery. In one place in Göttingen, which installation employs Körting gas engines and storage batteries, I was told that 10 lamps of the self-lighting type had been installed, and in four hours they were all burned out. The actual results at Göttingen, where they have about 300 lamps burning, show, I believe, that the open type of lamp did not last over 200 hours, and that the automatic or self-lighting type did not last over 100 hours. While I was at Göttingen a telegram arrived from Berlin requesting the return of all the new automatic or self-lighting lamps sent them a few days previously (some 300 in number), as there was something the matter with them. As they had already put out about 50 of them this could not be done. This would serve to indicate that even after several years of experimenting the A.E.G., who were the parent company, had not yet succeeded in making a lamp which was a thoroughly commercial article. During the past six months I have seen the Nernst lamp burning in the following places:—Paris, France; Munich, Bavaria; Buda-Pesth, Hungary; Berlin and Göttingen, Germany; and London, England, and my own impression is that the American type will shortly lead the way.

The A.E.G. have been for several months past putting out lamps in Berlin. They charge a rental or royalty of 3 marks (about 72 cents) per year, and 30 pfennigs (7·14 cents) for renewals.

The lamp globe holder and the butt which fits into the socket are sealed together by a lead and wire seal. I was informed that any of these lamps having the seals broken, or any lamps which were carelessly broken, had to be paid for at the rate of 3 marks each (about 72 cents). I was also informed that the users were compelled to give a receipt for the lamps, and every effort was made to prevent the lamps from getting into the hands of other people, and to prevent their being examined.

The Nernst lamp gives a most pleasing light; in colour it stands midway between the yellow and red rays of the incandescent carbon lamp and the violet and blue of the arc lamp; it is, however, so dazzlingly white that it is, as a rule, placed in ground glass globes, thus securing much greater diffusion, with a loss in the light probably not exceeding 15 to 18 per cent. I watched carefully the 54 Nernst lamps installed by the A.E.G. in the Café Bauer, in Berlin, this being one of their first installations, and the light certainly produces a much more pleasing effect than the carbon incandescent lamps (used in certain places in the same fixtures) and is also superior to the Welsbach mantles used in the same rooms. Arc lamps are also burned in front of the café, so that in

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

this one installation four types of lighting were employed, three of them being electrical.

During my three weeks' stay in Berlin, I observed carefully every evening the 54 lamps which were here installed, and which were doubtless, on account of their prominent position, of the best type made by the A.E.G., and I noted that there were usually from two to four or five lamps out, and even at times as high as eight or nine out; however, with an efficiency approximately half that of a carbon filament lamp a much shorter life may be permissible. It was also quite common—both in this installation and others, especially at the Paris Exposition, where the A.E.G. exhibited about 300 lamps—to see the lamp running with the heating coil in circuit, giving a dull and sickly light.

I have endeavoured to give the facts about the Nernst lamp development as observed by me during my recent sojourn abroad of over five months. I have no desire to disparage this remarkable and most promising advance in the electric lighting field, and well do I remember when an assistant at Mr. Edison's laboratory at Menlo Park, N.J., in the incipient stages of the development of the Edison carbon filament electric lamp, the difficulties met with, which at times seemed insurmountable. There were novel and knotty problems to solve such as the modern incandescent lamp manufacturer knows nothing of. Personally, I have no doubt of the ultimate solution of the peculiar problems met with in the manufacture of the Nernst lamp, nor of the immense value this invention will ultimately attain to the owners and the world at large.

In conclusion, without going fully into the history of the art, reference should be made to the work of Jablochkoff, who, in 1878, made use of sparks from an induction coil passing from one of the parallel carbon pencils of his "candle" to the other, and thus heating up the kaolin insulator placed between until it became a conductor, and the arc, once established, remained, being supplied by the dynamo current.

He subsequently used a piece of carbon mixed with syrup at the top of the candle, which a current of 100 volts heated until the kaolin became a conductor and the arc was supported.

At the Paris Electrical Exposition of 1881, and in the following year in London, "La Lampe Soleil" was shown, in which the arc from carbon rods played across the face of a block of marble until it became incandescent, and gave a most beautiful light.

The Osmium Lamp.

During my stay in Vienna last October, through the courtesy of Director Gallia of the Auer Company, I was permitted to see several of the new "osmium" incandescent lamps burning, and although I was unable to secure full particulars about this new and interesting development I learned that the lamp, which is the invention of Dr. Auer von Welsbach, operates at an E.M.F. of 25 volts and shows an efficiency of from ·9 to 1 watt per candle. The three lamps which I saw in use were all connected in parallel and operated with key sockets, and differed but little in general appearance from an ordinary carbon filament lamp. The globe was somewhat longer than an ordinary 16 c.p. lamp, and the filament, which was of the hairpin shape, was much longer. It must be used in a vertical position, owing to its flexibility. I was told that these lamps had shown a life under test of 700 to 800 hours. It will be interesting to learn to what extent the low voltage of the lamp and the rarity of the material used in its manufacture will affect its commercial application. It had been intended to show the osmium lamp at Paris before the close of the exhibition, but there was not sufficient time. "Osmium," which was discovered by Tennant in 1803, is a blue-white metallic element and is almost infusible. For a long time it was known only as a crystalline grainlike material; and when fused in the electric arc, as a hard brittle substance unfit to be worked. I was informed in Paris, where I first heard of this lamp, that the successful method of handling this material, which has always been most difficult to work with, was due to a large extent to Mr. Waldron Shapleigh, of the American Welsbach Company, which concern controls the patent rights for the United States.

According to Engineer Scholz in his lecture before the German Incandescent Gaslight Company, on January 23rd, 1901, an osmium lamp after burning 1,500 hours was still intact, and had fallen off in candle-power but 12 per cent. Its efficiency at starting was 1·45 watts per candle-power, and at the end of 1,500 hours was 1·7 watts. It is claimed that as long as the filament remains intact it can be renewed several times. While the present range of voltage for these pure osmium lamps is 25 to 50 volts, a number of filaments can be connected in series or multiple series for higher potentials, and it is proposed to increase the resistance by coating or uniting the osmium with certain oxides. Mr. Scholz refers to a test conducted upon four 25-volt osmium lamps in series, and four 100-volt carbon lamps in parallel; the osmium lamp showed a consumption of 0·96 ampere, and the carbon lamp 2·40 amperes, the former effecting a saving of 60 per cent.

A 20 c.p. osmium lamp run at 27 volts required 24 watts, and a 20 c.p. carbon lamp required 68 watts, the former effecting a saving of 44 watts, or about 65 per cent. The osmium lamp was much the coolest, by reason of its higher efficiency.

I have several dicarbide of calcium lamps, which have been manufactured to some extent abroad. They are the invention of Mr. Langhans, of Berlin, to whom I am indebted for them.

It may interest some of our members to learn that the Allgemeine Elektricitäts Gesellschaft of Berlin, are now making all their carbon filament lamps without platinum leading-in wires, using, so I have been informed, iron wire, the sealing being done in an atmosphere of carbon monoxide. The A.E.G. purchased the patent from Schott, the well-known glass manufacturer of Jena. I am told these lamps give out quickly, diminishing to a dull red. In London I found a company which has been formed for the purpose of "rejuvenating" incandescent lamps. The filaments which have gone off in efficiency and candle-power are taken out of the globe and treated, the globe cleaned of its smoky deposit and the lamp resealed and re-exhausted. I did not learn just how the globes were to be cleaned or what the rejuvenation was to cost. There are also several lamps known as "watt" lamps being exploited in Europe. They have a high efficiency, and are very simple, and cheaply constructed, and have a life of perhaps 200 to 400 hours. They make no pretence of being long-burning, but rely upon their high efficiency and low first cost.

(To be continued.)

INSTITUTION OF ELECTRICAL ENGINEERS.

A WATT-HOUR METER.

By Frank Holden, Member.

(*Paper read May 2nd*, 1901.)

One of the earliest schemes for the measurement of ampere or watt-hours was to have an ampere or watt-meter, or, commonly, something apparently assumed to be one or the other, to indicate a distance or angle proportional to the amperes or watts, and, combined with this instrument, an arrangement for recording this angle or distance, and making a summation of the records. The final sum would, with a perfect instrument of this kind, be proportional to ampere or watt-hours for the period during which the summation took place, at least very closely on commercial circuits of almost any character if the instrument were allowed to record for a considerable time.

This is true for the reason that, while a considerable percentage of the individual readings may be in error, yet when a large number of these readings are made, these errors practically cancel out, as positive and negative errors of each particular size are equally likely to occur.

An examination of almost every if not every meter of this type shows that it either had an apparatus not sufficiently accurate in indicating the angle or length proportional to the watts, or was deficient in means for recording the same, even were it correctly indicated, and not uncommonly there was trouble in both respects. In addition to these difficulties, there was commonly an electrically-wound clock that would not work for any extended period of time.

The meter which is the chief subject of this paper does not, perhaps, in strictness, belong to this class, but it more resembles these meters than any others that have been heretofore described. For the purpose of comparison, and for illustrating how this idea has been carried into practice heretofore, one of the most intelligently designed and successful of these meters, the Frager, will be described. It is shown diagrammatically in fig. 1.

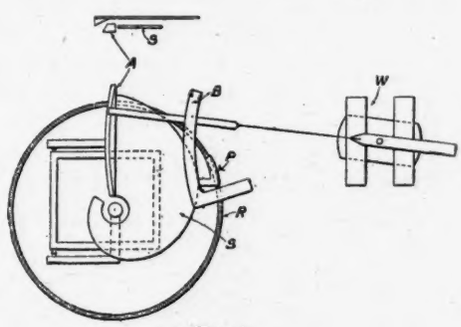


Fig. 1.

In this figure, W is a watt dynamometer, the fine wire coil of which, suspended by a wire, carries a pointer, the end of which moves over the sheet metal snail or spiral S.

An electrically-driven clock device uniformly rotates the vertical shaft carrying the snail, which makes one revolution every two to five minutes, depending on the size of the meter. With this also rotates a pawl, P, which lies over the circular rack R, which is geared to the indicating dials.

The snail revolves until the wedge at the end of the pointer meets the metallic arc, when the pointer end with the wedge is raised until the pointer is locked by being pressed upward against the milled under-surface of a bridge piece B, under which it moves freely until the recording operations begin.

In time, the pointer end passes over the radial edge of A, which also revolves, and, dropping on to the snail, depresses it, causing the pawl P to engage the rack, when the latter begins to revolve with the snail, and continues to rotate until the pointer passes over the edge of the snail, when the latter raises and releases the pawl. The angle of rotation depends on the angle of the arc traced by the pointer on the snail, and this angle is dependent on the shape of the bounding curve and the position of the pointer just before and during the making of the record. It is evident that, by pro-

perly shaping the bounding curve of the snail, this instrument could be made to indicate watt-hours under ideal conditions.

Taking into consideration the length of the pointer, 23 cm., and one's general experience with reading of instruments at zero, it does not seem likely that a reading of the pointer high or low of 1·5 mm. would be other than common. The length indicated by the pointer on the circular edge of A at full load is 76 mm., so this would mean an error of 2 per cent. at full load, 8 per cent. at quarter, 20 per cent. at one-tenth, and 40 per cent. at one-twentieth load; and a displacement of even 0·7 mm. would mean errors nearly as great as one-half these values.

Another source of error is in recording the deflection of the pointer, but in this particular instrument the error in doing this must be very slight, as the length of the arc traced on the snail by the pointer when the load is as low as 2 per cent. of the full load is 10 mm., which could be recorded on the circular rack within 2 or 3

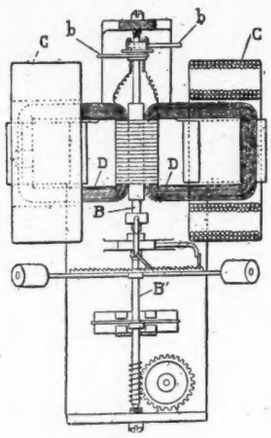


Fig. 2.

per cent. without necessitating too great structural refinement. When the load is double this, the arc on the snail becomes 20 mm. long, which, with the same refinement, would be measured within about 1 per cent., while above this the errors would certainly be negligible.

As there are a finite number of teeth, it follows that the distance moved by the pawls engaging the rack will not, in general, be an exact multiple of the space of one tooth of the rack, so that, in general, each record would be too low by some fraction of one tooth. But the error from this source may be eliminated by setting the pointer to read a little high at zero.

The fatal feature of this then, as a measuring instrument, would appear to be the impossibility of getting sufficiently accurate reading at low loads with so short a scale as 76 mm., and this has been the general failing of all instruments of this class.

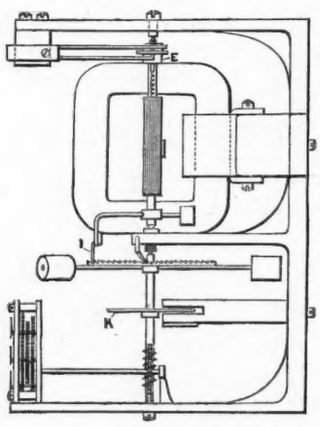


Fig. 3.

Instruments of this type have, in the past, been so uniformly unsuccessful and short-lived, that it would seem a most unpromising field in which to work. However, they have for the most part, if not always, failed for very specific defects in either the clock-winding or measuring part, which it seems one could have foretold as being fatal ones; at least, one can see it plainly now.

In the meter to be described, there has been an attempt at avoiding these defects by what are, in so far as the writer knows, new constructions, both in the clock-winding and the measuring mechanism.

The measuring part of this meter is shown diagrammatically in figs. 2, 3 and 4, in which C, C are the main current coils, partly enclosing the shunt coils D, D, which are mounted on the vertical axis, B. In the construction as shown here, it was intended to connect the coils astatically, so as to avoid any disturbing effect of the earth's field; but as the effect is of no commercial account, a more simple and powerful non-astatic arrangement of coils has been adopted for the future.

The axis B carries at its top an ebonite cylinder E about 6 mm. in diameter, holding the terminals of the coils D, D.

To each of these terminals is soldered a phosphor-bronze strap, about 0·0013 cm. thick. Each strap, after being wrapped partly around the cylinder, is soldered to the end of a very light spring F, which, again, is soldered to a stiff spring, mounted on an ebonite block. As may be seen from the figures, these straps tend to give the coils a clockwise rotation around the vertical axis, and the value of the rotating couple may be varied by means of adjusting screws, G. The effect of the currents is to make the coils rotate in opposition to the springs.

Coaxial with this axis, and below it, is another shaft, B', carrying a circular rack, which rests on three arms, which carry at their extremities three masses which may be screwed in or out for balancing purposes, a construction which has been adopted as giving a high moment of inertia for its mass.

Further down is a cast-iron disc K, which passes through the poles of a permanent magnet, and lower still is the usual worm and counting mechanism.

Together with this, there is a clock, which will be described hereafter, for closing the shunt contact periodically, say once a minute.

On the closing of the shunt circuit, the coils D, D are rotated to the limits allowed by the surrounding coils, and at the same time

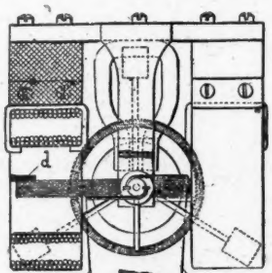


Fig. 4.

the pawl I engaging the rack imparts the same angular velocity to the lower part, which continues to rotate after the coils D, D are stopped, until the magnetic hysteresis in the disc K and mechanical friction bring it to rest. It is prevented from returning except very slightly by a stationary pawl. The shunt circuit being broken, the coils D, D return to their initial position.

Let—

P = Average couple exerted by the coils for one watt being measured.
S = Average moment of force exerted by the springs.
D = Average moment of the force due to hysteresis in the disc.
I_c = Moment of inertia of the deflecting parts, the shunt coils.
I_r = Moment of inertia of the revolving part.
θ = Angle of deflection of the coils or deflecting parts.

When the coils are deflected because of the currents for producing 'w' watts, the work done on all the moving parts is—

$$w\,P\,\theta.$$

The work done on the springs is—

$$S\,\theta,$$

and the work on the iron disc is—

$$D\,\theta,$$

Therefore the energy of the moving parts just before the coils are brought to rest is—

$$(w\,P - S - D)\,\theta.$$

Of this total, the portion in the revolving part is—

$$(w\,P - S - D)\,\theta\,\frac{I_r}{I_r + I_c}.$$

The angle through which this will rotate before coming to rest is found by dividing by the moment of the force tending to stop it, that is, D. The total angle of rotation, ϕ, measured from the starting position, obviously will be this, plus θ.

That is—

$$\phi = \theta + \frac{(w\,P - S - D)}{D}\,\theta\,\frac{I_r}{I_r + I_c}.$$

This reduces to—

$$\phi = w\,\frac{P\,\theta}{D}\,\frac{I_r}{I_r + I_c} + \theta\,\frac{D\,I_c - S\,I_r}{D\,(I_r + I_c)}.$$

The first term of the second member of the equation is equal to the value of the watts multiplied by a quantity involving only constants, and, therefore, if ϕ is to be proportional to the watts, then the second term not involving W must be equal to zero.

$$\frac{\theta\,(D\,I_c - S\,I_r)}{D\,I_r + I_c} = 0 \text{ or } S = \frac{D\,I_r}{I_r}.$$

If this relation between S and D be established, then—

$$\phi = W\frac{P\,\theta}{D} = W \times \text{Constant}.$$

This apparently does not take into account the effects of friction but, as a matter of fact, the frictional effects are nearly constant, and so merely change the apparent value of S or D.

The assumption is made, however, that the ratchet is perfect, and that it will hold the rotating part wherever it stops, whereas really the teeth are about 0·5 mm. apart; but how this affects the readings will be shown later on.

(To be concluded.)

INSTITUTION OF ELECTRICAL ENGINEERS (DUBLIN SECTION).

NOTE ON A HUMMING TELEPHONE.

By F. Gill, Member.

(Paper read April 18th, 1901.)

My excuse, if one be needed, for bringing this matter before you, must be that our late revered chairman, Prof. FitzGerald, was interested in the matter when it was brought under his notice, and further that, so far as I have been able to ascertain, the behaviour of the humming telephone, as I hope to show it, is new, and has not been published hitherto. This note is merely a record of a few experiments carried out at odd times since the effect was first noticed two years ago.

The ordinary humming telephone is, of course, well known, and was first noticed by A. S. Hibbard, of the United States, in 1890.* We have Hall effect and Ferranti effect; why not Hibbard effect?

In Hibbard's experiment a telephone is held against or near to the diaphragm of the microphone, and a hum or whistle is set up and continues.

A rough explanation of the experiment is that in the first place some slight noise is taken up by the microphone, and the sound is, in the usual way, given out by the telephone, but because the latter is near the microphone the sound waves set up by the telephone affect the microphone, which in turn again acts upon the telephone, and thus the reaction is maintained.

The connections in this case are those ordinarily used in telephony, fig. 1, where the microphone is in series with the battery

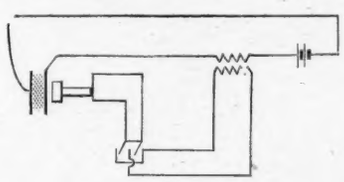


Fig. 1.

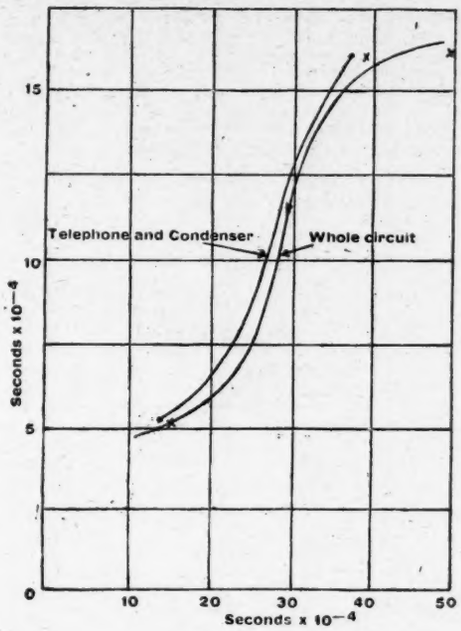
and with the primary of the induction coil; the telephone is in series with the secondary of the induction coil, and I have added a reversing switch.

The feature which I believe to be new is that if the wires leading to the telephone be reversed while the instrument is humming the note at once changes in a striking degree, and if the hum is stopped it will recommence again, high or low, according to the side the switch is set. It is also to be noted that the high note starts more easily and is altogether more vigorous than the low note. Of course, reversing the current in the primary circuit also produces the same change in pitch, and if the primary and secondary circuits be each reversed simultaneously no change is observed.

Returning to the ordinary humming, the exact conditions which determine the note given by the telephone appear to be most complex; apparently every portion of the circuit and instruments has a share in what the note shall be, but the note can most easily be varied in one of the following ways:—By altering the conditions of the circuit by adding resistance, capacity or self-induction. Speaking generally, if a non-inductive resistance be added into the secondary circuit the pitch of the note goes up, and at the same time the sound becomes weaker by attenuation. In this experiment I think there is a good deal of condenser effect across the winding of the coils of the resistance box which is used as a non-inductive resistance.

Adding capacity across the telephone lowers the note. It is quite easy to compare roughly different capacities in this manner; for instance, in trying this, three condensers of ·96, 1·1 and 1·3 microfarads respectively were at once picked out in their proper order, the condenser with the lowest capacity giving the highest note.

The curve shown in fig. 2 gives the result of adding capacity. The time of the note observed is plotted with the period of the



$$T = \frac{2\pi}{\sqrt{\frac{1}{CL} - \frac{R^2}{4L}}}$$

Fig. 2.

whole circuit, neglecting the primary circuit, and is separately plotted with the period of the telephone and condenser only. The curve is given as a result obtained on a few trials, and I do not attach any fanciful importance to it.

Adding self-induction to the circuit lowers the pitch of the note.

I show an interesting case. The secondary circuit is open as in fig. 3 (*a*) and is connected to a coil without iron and having two

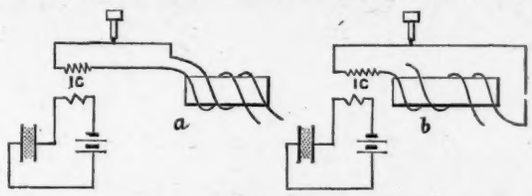


Fig. 3.

wires wound thereon side-by-side for about 2,800 turns. The capacity between the two wires is ·06 mfd. and the self-induction of each coil is ·1. If the connections are made to the wires entering at, say, the left hand end, the note is higher than if connected to opposite ends as in (*b*); in one case the difference was from 2,280 to 2,120 vibrations per second. This is due to an alteration in the induction, which is less when the wires enter at the same end as in (*a*), than when they enter at opposite ends, as in (*b*), and consequently the note given in (*b*) is lower. Conversely the addition of resistance in parallel (leakage) lowers the note, and self-induction in leak or capacity in series raises the pitch.

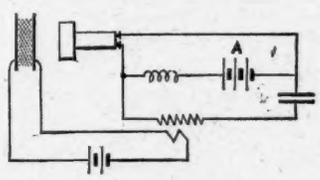


Fig. 4.

The note may also be varied by altering the current in the microphone. Increase of current causes the note to become very slightly lower in pitch.

The strength of the field may be varied and alter the note. In this experiment the arrangement is as in fig. 4.

As usual, the primary and secondary circuits are used, but a con-

* *Electrical World* of New York, September 19th, 1890.

denser is in series with the telephone. Across the telephone itself is a shunt circuit of a battery and a self-induction. This allows the strength of the pole-pieces of the telephone to be varied while in use. The self-induction in the shunt circuit prevents too much of the humming current being shunted out of the telephone. If the current from A is applied so as to strengthen the magnets of the telephone the note goes up in pitch and becomes louder, while if the current is sent in the reverse direction, almost at once the hum is stopped. In the telephone tried (an Ader) the current, strengthening the field, was varied from 8 to 112 milliamperes and showed a rising note; when, however, 17 milliamperes were sent round the telephone in the direction to weaken the magnets, the hum ceased. If a current be used to strengthen the field, the humming generally may be the more readily set up.

Variation of the distance between the two diaphragms gives an alteration in the note. On the high note side, increased distance gives higher pitch. On the low note side, as the distance between the two diaphragms is increased, the pitch rises until a sudden change occurs in the character of the note. If a tube be used to confine the air waves, the difference in the notes at different distances is striking.

Pressure inwards on the telephone diaphragm causes the pitch of the note to increase.

The following are briefly mentioned as points which have been observed. In some cases the hum will not commence until the current in the microphone has fallen to a certain value. The current in the microphone in a number of cases was about ·18 ampere, being about 28 per cent. less when humming (low note) than when at rest (·25 ampere), and 40 per cent. less (·15 ampere) when giving the high note with no external circuit.

I am indebted to Mr. W. W. Cook for the following interesting case:—In a common battery circuit as shown, fig. 5, and using a

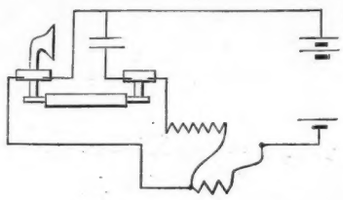
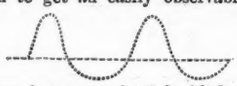


FIG. 5.

hand microtelephone, it is possible to set up the hum although in this case the diaphragms are not opposite to each other and are distant 8½ inches. The vibrations are undoubtedly conveyed through the handle. He states that he has easily heard this effect through 330 feet in the open air.

Mr. Duddell has been good enough at *very* short notice to put the current in the telephone through one of his portable oscillographs, and he gives the following approximate results—current r.m.s. 15 milliamperes at the low frequency. I understand the primary current was at 16 volts; this of course was high, and probably he used so high a pressure to enable him to get an easily observable curve immediately. Shape of curve 

On reversing the telephone connections, frequency about doubled.

The pitch of the note appears to be determined by the length of the column of air between the two diaphragms, and the conditions of the circuit. As the periodic time of the circuit is increased the note falls in pitch. To some extent the pitch is governed by the rate of the diaphragms, but I do not think this is so important a factor as the others. The main factors appear to be the angle of lag, and the length of the column of air between the diaphragms. Although the vibration is a forced one, it would almost seem that its rate is largely dependent on the free period of the circuit.

With regard to the alteration in the note when the telephone connections are reversed, Mr. Tatlow has suggested that this may be due to the fact that according to the direction of the current in the telephone its diaphragm will be moved in the same direction as, or in an opposing direction to, the diaphragm of the transmitter, and that while the former would tend to prolong the movement and so make a lower pitch, the latter would tend to force the rate. Although this seems probable, yet I have been unable to satisfy myself as to exactly what happens. It would appear also necessary to take into account that when the telephone diaphragm moves away from the magnet during increase in current, the self-induction of the telephone circuit is falling, due to the movement of the diaphragm, and there exists what may be compared to a negative resistance.

The humming telephone seems to be very similar to the humming arc so ably dealt with by Mr. Duddell and shown by Dr. Trouton, and its study by those who are ably provided with the necessary means of investigation would repay the labour.

With great diffidence I venture to give what appears to happen from my observations:—

When the microphone diaphragm moves in, the current increases, but owing to lag the increase in current does not coincide with the movement of the diaphragm. The telephone diaphragm apparently more or less accurately follows the current and send out its air waves; these waves, however, take an appreciable time to reach the microphone, and there is consequently an air lag as well as an electrical lag. So far as I can at present see, the high note is given when the diaphragm of the telephone moves (at the appropriate lag) in the *same* direction as that of the microphone, thus—microphone ((telephone, and the low note is given when the motion of the diaphragms is ( ). The diagram, fig. 6, is an attempt to illus-

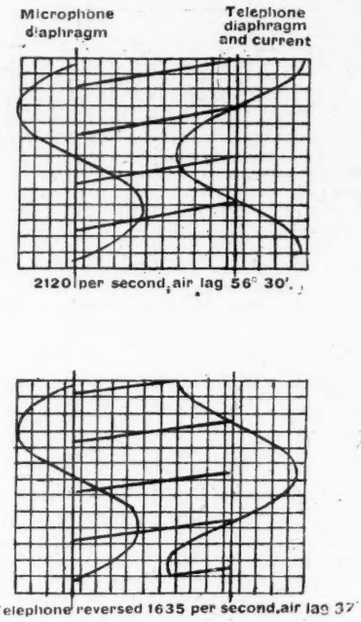

Microphone diaphragm
Telephone diaphragm and current
2120 per second, air lag 56° 30'.
Telephone reversed 1635 per second, air lag 37°

FIG. 6.

trate this. The figures taken are N = 2,120 periods per second, L = ·166, B = 145. The curves are drawn with a phase difference of 86°, and, with a distance of 1 in. between the diaphragms, the air lag is 56° 30′. The diagonal lines show the air lag. The figures with the telephone reversed are N = 1,635, L = ·166, B = 145, phase difference — 84°, air lag 37°.

It would be desirable if one of the masters would tell us what really is the maximum frequency which should be allowed for in telephone work. Dr. Pupin * says 750 periods per second is the highest that need be considered; Max Wien † states that the most characteristic notes of the voice lie between 500 and 3,000 per second; and Dr. Perry,‡ "as an exercise," takes 1,000 as the figure —one doesn't associate with Dr. Perry the taking of a figure, even "as an exercise," unless he had sufficient ground for so doing.

Besides those mentioned above, I would specially wish to tender my thanks to Dr. Trouton, Mr. Sinclair, Mr. C. J. Phillips, and Mr. France. I also desire to thank Mr. J. M. Shackleton for the very great assistance he has given.

APPENDIX.

The following measurements may be of interest:—

Ader telephone.	Resistance.	145ω
	Self-induction at 10 milliamperes.	·134
	Diameter of diaphragm, tinned.	2·12 in.
	Thickness " "	8 mils.
Deckett microphone.	Resistance at rest.	10ω
	Resistance at rest. High note with circuit induction coil and telephone. (Both of these figures taken from amperemeter readings.)	23·5ω
Induction coil.	Primary resistance.	1·05ω
	Secondary "	25ω
	Secondary self-induction at 22 milliamperes.	·032
Frequency of note in three observations. Primary volts four.	As in fig. 1. High note.	2,120 vibrations per second.
	As in fig. 1. Low note.	1,635 vibrations per second.
	As in fig. 1. High note side, but with 2·4 microfarads across telephone giving low note.	620 vibrations per second.
Amplitude of vibration of diaphragm of Bell telephone. Primary volts 4.	As in fig. 1. High note.	1×10^{-3} mm.
	As in fig. 1. Low note.	6·8 " "
	As in fig. 1. High note side, but with 2·4 microfarads across telephone giving low note.	12·6 " "
	Do. do. Another trial.	16·5 " "

* *Transactions of the American Institute of Electrical Engineers*, 1900, Vol. XVII., p. 255.

† *Ann. der Physik*, No. 13, 1901.

‡ *Phil. Mag.*, August, 1893, p. 224.

Fröhlich* gives the amplitude for a Siemens loud-speaking telephone as 35×10^{-8} mm., and V. Wietlisbach† gives the amplitude of a Siemens telephone (apparently not loud-speaking) for "a loud tone" as 52×10^{-6} mm. with a current of 12×10^{-4} amperes.

POINTS IN THE DESIGN OF ELECTRIC POWER PLANTS.

If we were to judge by many power plants we have seen, we should say there is room for further information on the subject of design and proportion. Mr. Philip Dawson has such an article in the current number of *Traction and Transmission*, and he begins by stating that the first requirement is the amount of energy to be consumed. This is always a matter of some difficulty.

Canvassing a town for lights does not give much of an idea of the power that is likely to be required before the station has been long at work.

Some few householders and shopkeepers have their minds at once fixed upon the new light, but large numbers do not move until they see the light in operation. Probably there is no better guide than experience. The records of a few somewhat similar places, showing the rate at which lamps were added, may be some guide. For a power plant the first desideratum is the number of cars that will be at work, and experience shows that this is a quantity apt to grow rapidly. Mr. Dawson points out three bases of estimate, viz., the number of motor cars to be run; the number of motor and trailer car-miles; the number of ton-miles. The last ought to be the most reliable, but in practice it is not so. The best method is stated to be to work out the power on the average daily car-mileage estimate.

Given a fairly close estimate of mileage, we fully agree with this method. A table of energy consumption per car-mile shows from a little below 0·5 unit up to as high as 1·37 for Glasgow, but the usual English rate is about 1·00. There are several German systems averaging 0·6 to 0·7. Throughout the speed is given at from 6 to 8 miles per hour as an average, including 6 in Glasgow. We cannot think these speeds are correct. Glasgow cars certainly do not average 6 miles per hour all the hours they are outside the station. Possibly Mr. Dawson excludes the stopping times, for an average of 6 miles an hour in the city as an inclusive average is a very high speed that is only secured where there is a fair proportion of suburban or semi-country traffic with free roads. As a fact an average speed of 8 miles per hour means considerable running at a speed of 20 miles.

As regards the power installed, this is found to vary from 5 to 55 KW. per motor car. Indeed, there has been known to be installed a plant capacity of nearly 70 KW. per car on the average regular running, but this plant would occasionally be kept so busy as to drop the ratio to about 23 KW. per car. Mr. Dawson's table is useful where all the facts are known, but it is not correct in all its details. For example, Dudley and Stourbridge is credited with three cross-compound 100-KW. engines for a track of 6 miles, whereas the track is really about 3 miles, the other 3 miles being run on current purchased from the Dudley Corporation station.

Certain figures for other lines are equally incorrect or out of date, and it is not desirable to trust much to such tables of data unless the full facts are known. Mr. Dawson's figure of kilowatts per car owned, including reserve power, is 8 to 12. This is fairly correct, for at 12 amperes average per car run there would be required 6 KW. per car. At least half the cars may be run all the time, which means 3 KW. for each car owned. Then at busy times in a small system it is often the case that every car is run. This again brings up the KW. to 6 per car owned, and there would thus be engines installed with a margin of 2 KW. on a total output of 6 KW. It is, however, essential to consider the proportions for a system, because the power installed must be able, with one spare unit, to deal with the maximum load at nearly full speed. In a large system the mean daily load may be 60 to 80 per cent. of the maximum load, but in a small system it may not be 20 per cent. Figures are lacking on this subject, but there is evidence to show that fairly close approximations can be made to the load factor that may be expected, and that the general average of cars running is not above 50 per cent. of the cars employed, *i.e.*, about half will be in the shops, painting, overhauling, &c.

If we assume a small system owning 12 cars and allow an installed capacity of, say, 12 KW. per car, this gives 144 KW.—say, 150. In practice there would be six cars at work at 5 to 6 KW. each. This represents 30 to 36 KW. As the load factor would be about 20 per cent., the maximum output would be 150 to 180 KW. With three sets and two only at work the nominal running plant capacity would be 100 KW., and it would for a short time run at 150 KW.

Similarly, if a system owns 90 cars and runs 60 of them and power be installed at 8 KW. per car owned, the total capacity would be 720 KW. in, say, three sets, or a running plant of 480 KW. The 60 cars would consume, say, 5 to 6 KW. each, or 300 to 360 KW. The load factor might be 50 per cent., and the maximum output therefore 600 to 720 KW., and here again the plant of 480 KW. should be able to carry over the peaks. While agreeing with Mr. Dawson's figures, we cannot but remark how they serve to direct attention to the enormous extent to which small systems must be over capitalised in power as regards engines, and how favourable the field appears for good accumulators. Mr. Dawson gives another table almost wholly from German sources. Half of the systems have batteries, but these do not appear to make much difference in the total power installed, as they should. This looks as though much dependence had not been placed on the cells.

Three solutions are given for the distribution system when beyond the scope of 500-volt direct current. (1) High tension polyphase at 5,000 to 15,000 volts or upwards, with transformers and rotary converters. (2) Continuous generation at 500 volts with boosters in the positive or negative feeders, or both, combined possibly with accumulator sub-stations fed by boosters, either at the sub-station or at the power station. In either case special high tension feeders run to the sub-stations. (3) Several independent power stations distributed about the system, and connected to the feeder network in *parallel*.

We italicise the parallel because, in our opinion, it is very important that the whole network should be of such a quality of material and workmanship as to permit of parallel working, without too much risk of accidents putting all stations out of circuit. The frequent shorts on a badly built system may compel the subdivision of the feeder system. This means, of course, that the system is split up into so many small systems, each with its excess of plant, its small load factor and excessive coal consumption, which will increase as the system is split up into small sections, the increase approximating to the cube root of the number of divisions, or as $\sqrt[3]{N}$. Thus for a division into three separate and distinct systems, the addition to the coal bill will be 44 per cent., against which there can only be set the advantage that accidents are restricted to small areas only; an increase of even 20 per cent. of fuel would be a heavy price to pay for cheap and poor construction. In nearly all cases of traction, continuous current has so far been chosen, but for lighting or power supply generally, this does not apply. The present tendency appears to be towards the concentration of power at one station, with high-tension polyphase distribution. Boosters appear to be restricted to smaller systems having long distance lines. Power can be generated more cheaply at one than at several stations, and the author would prefer polyphase plant when a minimum of 5,000 KW. output is expected.

In the city of Buffalo, current transmitted 20 miles, at 10,000 to 15,000 volts, is transformed at sub-stations in the city, but the old steam plant is still kept as a reserve in case of accident to the converters. This is a serious charge, or would be for a new system to incur. But the power company only charge a maximum of 1d. per unit for 1,000 units or less per month, and as low as 0·32 for 200,000 units. Accumulators are favourably considered for small systems; but the plant needs to be well designed. The engine power must be economical at the mean load, and must neither overcharge the cells nor allow them to run down. As an example, Plymouth tramways with 12 cars on the line would show current consumption varying in a few seconds from 0 to 250 amperes, as may be seen in any system of the size without cells. A battery placed in parallel with the generator reduced the fluctuation on the generator within 25 amperes on either side of the mean output, and this could have been further reduced had the battery been larger. An ideal design is one that leaves the battery nearly charged at the end of a day's work. It should, of course, be capable of being fully charged up as the load falls during the shedding of the cars.

The somewhat different device of battery sub-stations was applied by the late Dr. Hopkinson with some success. They are charged through a booster and put in parallel with the line. They lend themselves to main line work where heavy starting currents are called for locally. Summarising, the procedure of design is as follows:—

1. Settle on present and probable future power demands.
2. Decide on the best site, bearing in mind that the system of distribution should be subordinate to questions of coal, land and foundations.
3. Determine the number and size of units, bearing in mind the uniformity and superiority of large and few units within reason.
4. The system must then be determined. Three-phase will be usually advisable where rotary converters are employed for traction work. Voltage will be fixed by the amount of power and the distance of transmission and the system.
5. The type of engine can next be fixed and generally the station plant.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The extent to which German manufacturing companies are endeavouring to monopolise the electrical engineering trade in the Continental countries of Europe, with the exception perhaps of France and Belgium, is a remarkable movement which deserves the attention of British firms at the present time and in the future. The footprints of the enterprising Germans may be found in all directions, and with the assistance of financial syndicates and industrial banks these traces soon assume the form of a substantial interest in new undertakings outside the Fatherland, or the formation of subsidiary companies especially for the purpose of promoting the respective businesses of the firms concerned. A search for similar action on the part of British capitalists would probably end in failure—not that Germany itself would prove a profitable market, except in isolated cases—whilst even the Americans have as yet practically left the Continental field

* *Electrical Engineering* (Chicago), January, 1897, p. 26.
† *Ibid.*, p. 30.

entirely alone. Thus our Teutonic friends have a large sphere of activity open to them, and are utilising it to their future advantage.

As far as Norway is concerned, that country is attracting a considerable amount of attention. Some time ago the Siemens and Halske Company, of Berlin, became interested in a Norwegian undertaking for the purpose of pushing its business in that country. It is now reported from Christiania that the Allgemeine Elektricitäts Gesellschaft has followed its example by participating in a company formed to acquire the large works of Ch. Wisbech, whilst the Lahmeyer Company has also secured a controlling interest in Klosteron's works at Skien on the Christiania Ford. In this connection it is to be noted that the Lahmeyer Company has also invaded Italy by the formation of the Societa Italia Lahmeyer di Elletricita in Milan, with a capital of £25,000, the founders being Count Pulle and Baron Cantoni, and Prof. Salomon and Herr Schmidt, of the original Frankfort house. The severe competition of German firms in the matter of the supply of machinery and electrical plant in Italy is complained of by Messrs. Gaddae, of Milan; whilst on the other hand, a firm of such standing as Pirelli & Co. of that city has found the Spanish import duties too much for carrying on a profitable trade in cables, conductors, &c. It is proposed to overcome this difficulty by the establishment of a branch in Spain, and the company's share capital has just been increased by £40,000 for this purpose. The question of erecting a cable factory has been considered in Belgium, but the idea has been abandoned, because it was thought that the home demand would not fully occupy the works, and that profitable foreign orders could not be obtained in competition with the existing cable factories and the over production of their works. This position of affairs has, however, not deterred the Felten & Guilleaume Company from deciding to make an experiment in Austria, where the consenf of the Government has just been obtained to the formation of the Austrian Felten & Guilleaume Company for the establishment in Vienna of works for the manufacture of cables and the treatment of steel and copper. The only recent case of American action is the constitution in Berlin of the Westinghouse Electricity Company with a capital of £50,000 for the purpose of promoting the Westinghouse interests. The supervising council of the new company contains the names of Messrs. L. Bannister and P. F. Kobbe, of London, W. E. Smith, of St. Petersburg, O. Mueller, of Buda-Pesth, and A. Fuhr, of Hanover. Another promotion is that of the Swiss Oerlikon Company which has formed the Russo-Swiss Oerlikon Company with a capital of £40,000 for the development of trade with Russia.

The above mentioned instances refer only to the promotions of the past two or three months, and at a time when the electrical engineering industry is not in such a flourishing condition as it was a year or two ago. Many other cases of a similar character and referring to Russia, Roumania and other countries, have occurred at an earlier period than the present time. These external extensions, combined with the creation of new business in Germany, have rendered it more urgently necessary for new outlets to be provided for German home manufacturers, especially in view of the low prices which have prevailed during the past 12 months. In fact, the advances in the cost of raw materials and the depression in manufactured prices during the past year are not encouraging symptoms for many of the works, whose balance-sheets may perhaps have to record diminished profits, if not reduced dividends. However that may be, it is advisable for English firms to keep themselves acquainted with the progress or retrogression of the manufacturing concerns on the Continent. The working results of some of these undertakings may be briefly summarised as follows:—

GERMANY.

Cable Manufacture.—The North German Marine Cable Company (Norddeutsche Seekabelwerke Akt. Ges.) of Cologne, is a comparatively new manufacturing enterprise which has already made a fair commencement. Formed in May, 1899, with a capital of £200,000, at the close of 1900 the amount paid up was £175,000, one-half of which is held by the German Atlantic Telegraph Company. The company's cable factory was set in operation last October, and the profit of £4,433 has been entirely written off for depreciation. Besides receiving a small order from the German Atlantic Telegraph Company, the company was commissioned by the German Post Office authorities at the end of the year to construct a new four-core cable for laying between Germany and England. Last autumn the company's cable steamer laid for the Government a new cable 470 kilometres long between Tsingtau and Shanghai. It is proposed to remove from the central offices in Cologne to Nordenham, where a branch establishment was opened in August last year.

The business of the Land and Marine Cable Company (Land und Seekabelwerke Akt. Ges.) of Cologne—Nippes, which has a paid-up capital of £150,000, sensibly increased during 1900, although the prices obtained for some manufactures were not all that could be desired. After providing £7,769 for depreciation, the net profits amount to £17,602, as compared with £17,235 in 1899, and it is intended to distribute 10 per cent., as against 9 per cent. in the previous year. The directors express the hope that, notwithstanding the depression in the electrical industry, favourable results will also be obtained this year, as the large orders recently received will allow of a profitable utilisation of the plant for some months. Apart from the home factories, the company has become financially interested in the Rieben Cable and Wire Works of St. Petersburg to the extent of 80,000 roubles, and has placed its Russian business connections and technical experience at the disposal of that company in return for a preferential participation in its net profits. In addition to this the company holds a number of shares in the North German Marine Cable Company, to which reference was made in the preceding paragraph.

The absorption by the South German Cable Company (Suddeutsche Cabelwerke Akt. Ges.) of Mannheim, of the telegraph wire and cable factories of N. Lachman, of Berlin, A. Kreidler, of Stuttgart, and A. Schacherer, of Mannheim-Waldhof, which took place during last year, has had a temporary effect upon the position of the consolidated undertaking. It was found necessary to increase the capital of £100,000 to £150,000 in order to acquire these businesses, and although the total sum now being distributed is greater than in the previous year, the percentage paid on each share is less, in consequence of the additional capital which has been brought into service. After deducting working expenses, the gross profits show a considerable increase over those of the previous year, but as the general trading expenses were nearly triple, for some reason that the company's report does not explain, the net result is only a profit of £8,385, as compared with £8,200 in the preceding year. The dividend which has just been declared is at the rate of 6 per cent., as against 8 per cent. in 1899.

The position of the Duisburg Cable Company (Kabelwerk Duisburg), of Duisburg, which has a capital amounting to £55,000, is exceedingly unsatisfactory. The year 1899 closed with a deficit of £466, and the past year's operations have been even more disastrous. After writing off £2,295 for depreciation, as compared with £2,322 in 1899, the deficit has been increased to £14,360—a fact which holds out little promise of future success.

Although not a manufacturing concern, the German Sea Telegraph Company (Deutsche See Telegraphen Gesellschaft) of Cologne, will be remembered as the owner of the Borkum-Vigo cable, which is to be absorbed by the German Atlantic Telegraph Company (see the ELECTRICAL REVIEW, May 3rd, 1901) not later than the year 1904 by virtue of agreements between the companies and with two English cable companies. During the past year the working results have not been so satisfactory as in 1899. After transferring £4,271 to the cable renewal fund, as in the previous year, and writing off £121, the net profits, including £983 brought forward, amount to £12,058, as against £12,864 in 1899. It is proposed to distribute 5 per cent. among the shareholders, as compared with 6 per cent. in the preceding 12 months. The company's report states that the traffic increased in a satisfactory manner, although the expenditure was greater in consequence of a fault which necessitated repairs extending over 10 days.

Telephone and Telegraph Apparatus.—The flourishing condition of the Akt. Ges., Mix & Genest, of Berlin, continues to manifest itself in a remarkable manner, every extension of business apparently tending to improve the position of the telephone and telegraph works carried on by the company. In December last the shareholders adopted a resolution authorising an increase in the share capital of £130,000 by the issue of new shares amounting to £50,000. The whole of the issue was taken up by the Bank fur Handel und Industrie at the price of 160 per cent., and the greater portion of the new shares was recently offered to the existing shareholders for subscription. The explanation of raising additional capital at a premium of 60 per cent. is to be found in the progressive financial development of the undertaking. For instance, it was possible in each of the years 1896, 1897 and 1898 to pay a dividend at the rate of 10 per cent., which was increased to 12 per cent. in 1899, whilst it is now proposed to make a distribution of 14 per cent. for the past year. The gross profits for 1900 amount to £37,571, as compared with £30,092 in the previous year. Of this total the sum of £11,700 is provided for depreciation, £18,200 is required for the payment of the dividend, and the balance is disposed of by meeting expenditure and contributions to reserve fund.

(*To be continued.*)

TRANSFORMER PATENT LITIGATION IN AMERICA.

AN IMPORTANT DECISION.

THE important patent case of a year ago, in which the Zipernowsky-Deri patent for connection of transformers in parallel on the mains was declared invalid, is recalled to mind at the present time by a decision just given in a similar case in New York, but in this case the consequences will be much more serious, for the patent in question has been upheld. The action was brought by the Westinghouse Company against the Saranac Lake Electric Light Company for infringement of two patents for the use of transformers in parallel on a primary circuit. The first patent was that of Rankin Kennedy, No. 407,294, applied for in November, 1888, and granted in 1889; while the second was Stanley's patent, No. 469,809, applied for in August, 1888, and granted in 1892. The invention described in this latter patent had, however, been put in practice as early as March, 1886, as the American patent law allows an inventor to work his invention for two years before taking out his patent, provided it is not published in the meantime.

The ELECTRICAL REVIEW played a prominent part at the trial, as the defence relied upon previous publications in this

journal to upset the patents sued on. In one case they were successful, for the learned judge held that Rankin Kennedy's patent was invalid by reason of two letters from himself published in these columns. The first was that which was relied upon so strongly in the Zipernowsky-Deri action here, the "Prodigious!" letter of June, 1883. The other appeared in our issue for November 19th, 1886, where Rankin Kennedy took exception to Zipernowsky and Deri claiming that they were the first to connect secondary generators in parallel arc. We need not enter into the claim of Kennedy's patent, since it has been held to be invalid.

Stanley's patent, however, has been upheld, and when we examine what he has claimed, we see how very serious this decision will be for every electrical undertaking in the United States of America where transformers are used. We suppose, for the moment, that this decision will be held good on appeal to the highest courts. The feature of Stanley's patent is that he gives instructions how to make the transformers perfectly self-regulating, so that switching off lamps in the secondary will have no effect on those left incandesced, nor on the current supplied to other transformers. He lays down the principles to be observed in these words:—"The first thing to be determined is the length of the primary wire. This should be of such length that, reacting self-inductively upon its own magnetic circuit, the average counter-potential so produced approximately equals the potential applied to the primary circuit. When so constructed, an ammeter will practically show no current when the secondary circuit is open. To obtain these results in practice, I use the following method: I first choose the percentage of efficiency to be obtained; then, having selected a type of magnetic circuit affording as great magnetic conductivity as possible, I apply such a length of primary conductor that, acting self-inductively upon its core, the difference of the counter-potential and applied potential, multiplied by the current in the converter, shall equal the predetermined loss of energy inevitable in conversion, and vary the length of primary wire until the desired results are attained. . . . Having, by this means, determined the length of the primary coil, the secondary is adapted to it in such a manner as to secure the desired potential according to the well-known laws affecting the well-known operation of induction coils. I have usually related the potential of the secondary to the primary in the ratio of 20 to 1. The size of the wire in the primary and secondary is in inverse proportion to their electromotive forces." He then proceeds to describe what happens in a transformer thus constructed when lamps are switched off in the secondary circuit, and then states his claims. It will be sufficient to give here only the first claim, which shows by its terms how very far-reaching must be the effect of a declaration of validity of the patent. It runs thus:—

"In a system of electrical distribution and in combination, an alternating current dynamo and converters, electrically connected with the main line conductors in multiple arc and organised to transform the current in the main conductors into currents of less potential and greater quantity in the secondaries, each converter made with a primary coil containing such length of wire exposed to magneto-electric induction, that when operated by the dynamo with which it is to be used with its secondary circuit open, the electrical pressure and counter-pressure in its primary circuit shall be equal, with incandescent lamps or other translating devices in the secondary circuit, substantially as and for the purposes set forth."

The learned judge found that Stanley had been the first to prevent the varying candle-power of the lamps on a given transformer when some of the lamps were turned off or on. "Stanley found a solution," says the judge, "by doing what no one had ever thought of doing before. He discovered that he could remedy existing faults by regulating the length of the wire on the primary coil of the transformer. . . . . What Stanley did was an exceedingly valuable addition to the art. He remedied a serious defect; he secured, without unnecessary waste of current, constancy of secondary pressure as lamps were turned on or off; he struck out into a new path and brought back the prize which, if he had continued upon the old paths, he never would have found. Such a discovery cannot be attributed to the 'skill of the calling.'" The description published in the columns of the ELECTRICAL REVIEW in August, 1885, of the Zipernowsky-Deri plant at Buda-Pesth, was also set up as an anticipation of Stanley's patent, but the judge found that no information was given there upon the essential feature of Stanley's invention, the length of the primary wire, and the method of determining it. "It fails to tell electricians how the length of the primary wire can be correlated to the voltage and alternations of the current applied."

Looked at from the commercial point of view, it would appear that if this decision is upheld, practically every distributing company in the United States, including the great power companies at Niagara, will have to pay royalties to, and become licensees of, the Westinghouse Company; and as the patent has still several years to run, this payment will be a heavy tax upon the companies. There do not appear to be any similar patents in this country, so that, after the Zipernowsky-Deri action of last year, there is little probability of further litigation on this question.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

9,840. "Improvements in motor interrupters for use with induction coils." H. C. NEWTON. May 13th.

9,844. "An electrical transmission dynamometer and tachometer." C. V. DRYSDALE. May 13th.

9,854. "Improvements in life guards for self-propelled vehicles, used on street and road tramways or railways." C. MUSKER. May 13th.

9,865. "Improvements in apparatus for opening and closing electrical circuits." J. D. F. ANDREWS. May 13th.

9,882. "Improvements in and relating to electric arc lamps." G. M. LANE. May 13th. (Complete.)

9,883. "Improvements in controllers for motors." A. O. FOX. May 13th. (Complete.)

9,915. "Improvements in or connected with electric motors." W. H. FLOOD and A. E. HONEY. May 13th.

9,916. "Improvements in collecting-brushes and holders for electric machines." W. H. FLOOD and A. E. HONEY. May 13th.

9,925. "Improvements in the working of induction coils, and other apparatus with alternating and pulsating currents." H. C. NEWTON and R. S. WRIGHT. May 13th.

9,929. "The electric revolving brush." A. E. THOMAS and J. BUCKLEY. May 14th.

9,933. "Improvements in or connected with trolley arms, and in attaching same to the outside covers of electric tramcars." C. H. WILKINSON. May 14th.

9,959. "Improvements in incandescent electric lamp globes." E. BOHM. May 14th.

9,962. "Improvements in or relating to the pole-pieces of dynamos and other magneto-electric machines." A. STOCKTON and S. H. HAYWOOD. May 14th.

9,987. "Improvements in electric cables." J. D. GOULD. May 14th. (Complete.)

9,998. "An improvement in electrical lighting as applied to advertisements and the like." W. O. JENNINGS. May 14th.

10,010. "A new form of standard electric resistances for small and large current strengths." H. VON KRAMER and F. G. SHARP. May 14th.

10,058. "An improved trolley wheel for overhead wire systems of electric traction." E. M. MUNROE, H. BRECKNELL and H. I. ROGERS. May 16th.

10,062. "Improvements in moving coil electrical measuring instruments." A. ECKSTEIN and F. PANTER. May 15th.

10,063. "An appliance preventing trolley wheel from leaving overhead wire in electric traction." M. F. T. DEANE. May 15th.

10,080. "Improvements in or connected with apparatus for wireless telegraphy." H. R. B. HICKMAN. May 15th.

10,088. "Improved apparatus for treating affected parts of the body with heat, light or electricity in certain cases simultaneously." I. TIMAR. May 15th. (Complete.)

10,102. "Improvements in electrical switches." EVERED & CO., LIMITED, and C. HOLT. May 15th.

10,120. "Improvements in electric telegraphy." A. MUIRHEAD. May 15th.

10,130. "Improvements in life guards for electric tramcars or similar vehicles." T. J. KENDREW. May 16th.

10,166. "Improvements in printing telegraph receivers." A. J. BOULT. (The Joy Printing Telegraph Company, United States.) May 16th. (Complete.)

10,188. "Improvements in electric indicators for use in sectional telephone circuits." C. M. JACOBS. May 16th.

10,191. "Improvements in and in apparatus for the manufacture of the plates of electric accumulators." A. D'ARSONVAL and G. VAUGEOIS. May 16th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, December 27th, 1900, being date of application in France.)

10,202. "Improvements in safety devices for electric tramcars, and other motor-driven vehicles." A. RUTHERFORD, Jun. May 16th.

10,206. "Improvements in electric railway systems." B. CRUVELLIER. May 16th. (Complete.)

10,215. "Improvements in and connected with casings or coverings for electric conductors in buildings." J. H. GOLDING and C. A. JAMES. May 16th.

10,228. "A new or improved combined system of electric lighting and fire alarms, and appliances connected therewith." C. C. METCALFE. (H. C. Blackwell, Russia.) May 17th.

10,238. "Safety device for overhead electric wires." J. W. LITTLER and R. W. CREARY. May 17th.

10,249. "Improvements in or relating to electrical ignition apparatus for internal combustion motors." C. A. HAMILTON. May 17th.

10,250. "An improved safety device for preventing the breakage of telegraph and telephone wires and the like." E. W. Martland. May 17th.

10,275. "Improvements in controlling electric motors." The British Thomson-Houston Company, Limited. (M. W. Day, United States.) May 17th. (Complete.)

10,294. "Improvements in switches for use with lamp-posts for street lighting and the like." W. Sumner. May 17th.

10,295. "Improvements in electrically-operated desk fans." C. Schwabe. May 17th.

10,345. "Improved method of and means for forming joints on or connecting electric wires." J. Lightfoot and C. Monkman. May 18th.

10,357. "An improvement in electric conductors." Siemens Bros. & Co., Limited, and F. Jacob. May 18th.

10,374. "Improvements in or relating to step-by-step telegraphic apparatus." W. M. Mordley and W. S. Stelzes. May 18th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

15,641. "Improvements in dynamo-electric generators and motors." C. W. Atkinson. Dated July 28th, 1899. Dynamos and motors:—Consists of various detail improvements on the invention described in Specification No. 6,649, A.D. 1898. Frames and casings (ventilating):—The frame or casing B carrying the field magnets A consists of a central portion, the outer surface of which forms part of a sphere, and two cylindrical end projections J, J^1 united to the central portions by flat plates I, I^1. The spherical portion of the frame is adjustably supported in a base-plate C having a spherical recess on its upper side, or a number of projections D, the surfaces of which form part of a sphere. The side plates I, I^1 may be formed with openings for the inspection and ventilation of the field magnets, and these openings may be provided with covers of wire gauze or other suitable material. Field magnets:—The field magnet coils are wound on thin metal formers having corrugated ends, and these formers are secured in position by wedges inserted between adjacent poles, or by a circular ring of iron inside the poles. In the latter arrangement the ring is partly cut away between the poles so as to form pole-pieces. Armatures:—The laminated armature core is secured on its shaft by thin metal tubes formed integral with dished supports, and the tubes U are rolled down into grooves on the shaft, or over wire rings inserted therein. The winding is of the drum type, and the end connections are carried round on thin metal rings which are united to the dished supports. Commutators:—One of the end projections forms a casing for the commutator, and is formed with windows capable of being opened and closed by a rotary grid for the purpose of inspecting the brushes, &c. Brush-holders: The brush-holder is formed of thin sheet metal bent into rectangular form, and is supported by two pairs of pivoted links forming a parallel motion. This frame is supported in a carrier, by means of a spindle having flattened ends, whereby it is inserted into the carrier through slots. Terminals (arrangement of):—The terminals for the field magnet coils are secured by type metal or cement into porcelain tubes inserted into holes in the wedges which hold the coils in position, and contact spindles in connection therewith are similarly supported in the bearing casting. In another arrangement recesses are formed in the field magnet frame, into which insulating tubes supporting the terminals are inserted and retained by screw covers. The brush terminals are also supported in insulated tubes into the bearing casting. 9 claims.

15,720. "Improvements in electric arc lamps." Crompton & Co., Limited, A. J. Hodgson and C. F. Tubbs. Dated August 1st, 1899. Arc lamps:—A clutch lamp has a lever pivoted centrally and linked to the movable cores of two vertical solenoids or to the core of a single solenoid and a balance weight, and one core or the weight is also directly attached to an arm of a movable central tube carrying a washer or other clutch. The lever may be either over or under the solenoids. The upper carbon is guided in the clutch tube by a socket described in Specification No. 6,276 A.D. 1897. The piston of an air pot is carried on the top or an arm of the tube, or on one core. The solenoids may be series and shunt connected, or either series or shunt, one core being above and the other below when two series or two shunt solenoids are used. The solenoids may be carried by a plate on four vertical tubes which connect a cover and a base; two tubes extend down to carry the lower carbon-holder and an arc enclosing globe if one is used. The clutch may be releasable by contact with the cover of the arc-enclosing globe or other fixed part. 3 claims.

15,744. "Improvements in, or connected with, electric regulating switches." O. D. Lucas. Dated August 1st, 1899. Switches for use with regulating-resistances or with battery cells. A number of contact-levers may be mounted on a shaft, and be connected to be operated independently or together. The switch lever is mounted loosely on a shaft, and is moved by the handle to engage with the contacts. The contacts may be arranged in pairs, or the conducting-plate at the end of the lever may connect the contacts with a continuous contact-plate. The contact-lever carries a perforated segment, and may be locked to the shaft by means of a pin sliding in an arm fixed to the shaft. Several switches may be mounted on the shaft, and may be locked in any desired relative position. The pins may be held by a spring, or by a bayonet-joint connection. The shaft may be operated by hand or by suitable gearing, &c. 4 claims.

15,644. "Electrical ignition apparatus." F. Kupper and A. E. Vorreiter. Dated July 31st, 1899. An induction coil is enclosed in a slit iron box, and is surrounded by a condenser. The primary coil is attached to the box at one end, and at the other to the insulated screw. The secondary coil is also attached to the box, and to an insulated bolt secured by a nut. The box is screwed by the screw into the cylinder of a motor or other place, and a spark passes across the space and between the nut and box. 2 claims.

15,705. "Improvements in or relating to electric meters." J. H. Barker and J. A. Ewing. Dated August 1st, 1899. Motor meters are provided with demand indicators, by allowing a magnetic or other brake a small motion in opposition to a strong spring, and indicating the extent of such motion by a magnifying pointer on a stationary scale, either the brake or the pointer or an additional pointer being provided with a pawl to engage a stationary rack, by which it may be retained at the maximum indication. A magnetic brake may be added for this purpose to a meter having another fixed brake. The motion of the meter may be either rotary or oscillatory. The retaining pawl may be disengaged from the rack by a lever extending through the meter case, and protected by a seal. The pawl may be held out of action by a notched catch pivoted on the brake. In the form shown a rotating disc is acted on by two brake magnets secured adjustably by screws in a slotted yoke on an axle parallel to the meter axle. The magnet poles may be arranged astatically, and any effect on the armature balanced by a compensating magnet or shunt field winding. The brake axle is supported on a ball bearing in a bracket, is acted on by a spring, and has a horizontal arm in engagement with the magnifying pointer. To avoid error due to friction, the brake may be caused to oscillate slightly by making one or more holes in the disc. The brake may otherwise be hung by a torsion wire. For travelling, it is secured by screws to lugs in the frame. A disclaimer refers to Specification No. 8,068, A.D. 1896. 5 claims.

15,882. "Improvements in apparatus for operating two or more electrical regulating switches or resistance device together or separately." O. D. Lucas. Dated August 3rd, 1899. Relates to operating gear for groups of resistances or switches so arranged that any one can be operated independently, or two or more can be operated simultaneously. Each individual resistance is connected with a separate driving shaft fitted with a hand-wheel. These shafts may be connected with a main driving shaft by friction cones. 3 claims.

15,895. "Improvements relating to magnetic compasses." H. J. Hadden. (C. Helt.) Dated August 3rd, 1899. Relates to a registering and signalling compass. The bowl has placed around it a series of insulated contact strips connected to the terminals and thence to the battery and to the registering, &c., apparatus. These strips are placed symmetrically about a strip marked zero, at first being very narrow for marking degrees, but getting gradually wider as they get further from the zero, where delicate observations are not required. The card from which parallel magnets and copper counterweights are suspended is supported on a centre resting in a mercury cup connected to the battery. A wire leads from the cup to one of two rollers, between which rests a pointer, preferably a straw with copper armatures or thimbles at its ends. The pointer is placed east and west on the card, and it terminates in a palladium spiral, which normally is just out of contact with the strips. Then setting a course, the bowl is swung round by bevel and other gear operated by an external handle till the zero strip is opposite the spiral; the wires from the terminals pass down a hollow axle, which is simultaneously rotated so that the wires do not get twisted, and they end in insulated rings, from which the current is taken by brushes. The bowl is suspended by spring devices from a ring running on rollers on a rail. For delicate adjustment, the gear may be turned by speed-reducing gear, to which the handle may be fitted. At stated intervals, say every 30 seconds, a time switch completes circuit for a magnet which operates bellows connected by a pipe with other bellows, dropping a weight upon a plate and actuating the counterweighted bell-crank lever. This thrusts forward the pointer between its guide-rollers, the lower of which is fitted with a projecting guide-finger, so that the spring makes contact with the strip then in front of it, and actuates the register and signalling apparatus. The signalling apparatus consists of a series of bells of different tones. 5 claims.

15,904. "Improvements in and connected with transformer boxes." A. J. Lawson, J. D. Dallas, and E. T. Goslin. Dated August 3rd, 1899. The transformers, switches, &c., are so arranged in the box that the transformers may be used separately, or be "banked," or be cut out. The box is sunk in the ground, access being obtained through manholes. Each box is provided with interlocking doors, on which are mounted contacts, which close the circuits when the doors are closed. Omnibus bars are run along the length of the box, and suitable connections made. Switches are provided for connecting up to the concentric mains and to other boxes. Ventilating shafts are arranged in connection with the boxes. 1 claim.

15,973. "Improvements in and relating to the direct coupling or connection of rotary fans or pumps with electric or other motors or engines driving same." S. C. Davidson. Dated August 4th, 1899. Centrifugal fans and pumps are mounted on the same shaft as the electric or other motor that drives them, and their casing is secured to the flange by equally pitched bolts, so that the outlet may be altered to any position around the fan. Openings are made in the frame to allow air to enter and leave the fan on that side, and thus prevent it from withdrawing oil from the shaft bearing. 7 claims.

16,040. "Improvements in electric fuses and electric detonator fuses." G. Smith and D. Corrie. Dated August 5th, 1899. The wires are fixed by a plug of lead to the copper tube, which is closed in to secure the plug. The tube is pressed into the detonator tube, or may itself form the detonator tube. 1 claim.

16,083. "Improvements in controlling devices for electric currents." H. Cuenod. Dated August 5th, 1899. Relates to a device for maintaining constant the current produced by a dynamo or other electric generator. A coil carrying a portion of the current to be regulated is capable of a limited motion in the field of an electro-magnet. The said coil is carried by a pivoted lever and provided at its opposite end with a stop-piece. As the lever moves owing to variation of the current, the stop-piece is brought into the path of one or other of the tappets carried by bell-crank levers mounted on a rocking arm. By these means one or other of the clicks also carried by the rocking arm, is brought into engagement with a toothed wheel, which imparts motion to the regulating device, *e.g.*, the admission or expansion valve of the driving engine or the brush carrier of the dynamo. In order to adjust the lever it is connected at one end to a spring, the tension of which can be regulated by a screw. After actuating the controlling device, the lever may be rapidly returned to its normal position by means of a spring, connected through an oil or air pump with a lever actuated by toothed gearing from the shaft. 3 claims.

16,091. "Improvements in electrical apparatus suitable for lighting, cauterising and other purposes." J. Richardson and H. Ramsbottom. Dated August 5th, 1899. Relates to electrical apparatus adapted for lighting, cauterising or heating, and X-ray and other work. The battery consists of two or more cells connected to terminals so that they may be arranged in series for lighting, and parallel for cauterising, &c. On the face of the box is removably fitted the base of the rheostat. This consists of three coils, over which may move the contact-arms. The inner and outer coils are connected in series, and are used for regulating the lighting, and the other coil, which is fitted with contact-studs, is for regulating the heating. The base is detachable from the box, and is fitted with contact pins or plugs adapted to fit in sockets connected to the terminal board. The construction of a switch, for automatically connecting the batteries in series or parallel when the plugs are inserted, is shown. The contact-plate is normally in contact with a contact, and the cells in series for lighting the lamp, when the contacts are in the sockets, the plate is rocked by the pins striking a projection, causing it to make contact with a second contact and putting the cells in series. In a modified arrangement, the terminal, or switchboard is also placed on the base and connected to the battery by pin-and-socket connections. Another arrangement shows a switch for altering the connections of the battery. The plug carries an insulating-pin, which separates contacts forcing them against other contacts. In another arrangement, particularly adapted for X-ray work, additional cells are employed, and a rotary drum or commutator switch is fitted on the box for changing the connections. 3 claims.

16,133. "Improvements in alternating electric current motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated August 8th, 1899. Motors, alternating current.—A rotary magnetic field is produced by means of two groups of exciting coils arranged at right angles to each other, each of the said groups containing a primary coil and a secondary coil, the primary coils being supplied with single-phase currents, while the secondary coils are connected in a closed circuit with a resistance. By making the primary coils in the two groups of unequal but suitably-proportioned magnetising power, and the secondary coils also of unequal but suitably-proportioned magnetising power, and further by properly proportioning the magnetic resistances of the several magnetic circuits, the necessary displacements of phase are obtained for the production of a rotary field. A form of motor in which the exciting coils are disposed in recesses in a stationary field magnet and encircle the rotating member or armature is shown, comprising two primary coils, connected with the single-phase mains, and two secondary coils closed on a resistance. The necessary modification of the magnetic resistance is obtained by air-gaps. According to another arrangement, the exciting coils are wound on the rotating member of the machine, which has four poles with convex ends disposed at varying distances from the inner surface of the stationary member. A form of machine is also described in which there are four groups of exciting coils arranged 45° apart. Two or more motors of the kind above described may be connected together in tandem, the secondary winding of the first supplying current to the primary winding of the second, and so on. 15 claims.

16,140. "Electrical resistances and heating bodies composed of metallic oxides." V. I. Feeny. (Allegemeine Elektricitats Gesellschaft). Dated August 8th, 1899. A metallic oxide, such as an oxide of iron, copper, chromium, uranium, manganese, nickel, cobalt titanium, zinc, tungsten or molybdenum, or a mixture of these, to which magnesia or porcelain earth may be added, is powdered and made plastic with water or gum, and formed into rods or tubes. These are heated to incandescence, so that they contract considerably, after which they conduct electrically at ordinary temperatures, and are mounted between platinum, nickel, or other metallic infusible connections. They may be used as resistances, lamp filaments or heating bodies, especially for heating filaments which are non-conductive when cold. When used as filaments, guard resistances must be used in series with them. 3 claims.

16,225. "Improvements in conduits for laying electrical cables." W. H. Nicholls and W. T. Henley's Telegraph Works Company, Limited. Dated August 9th, 1899. Conduits of earthenware are formed preferably of rectangular section, and have the socket joints formed round the top and sides, but not on the bottom, so as to allow the sections to rest flat on the concrete bed. 1 claim.